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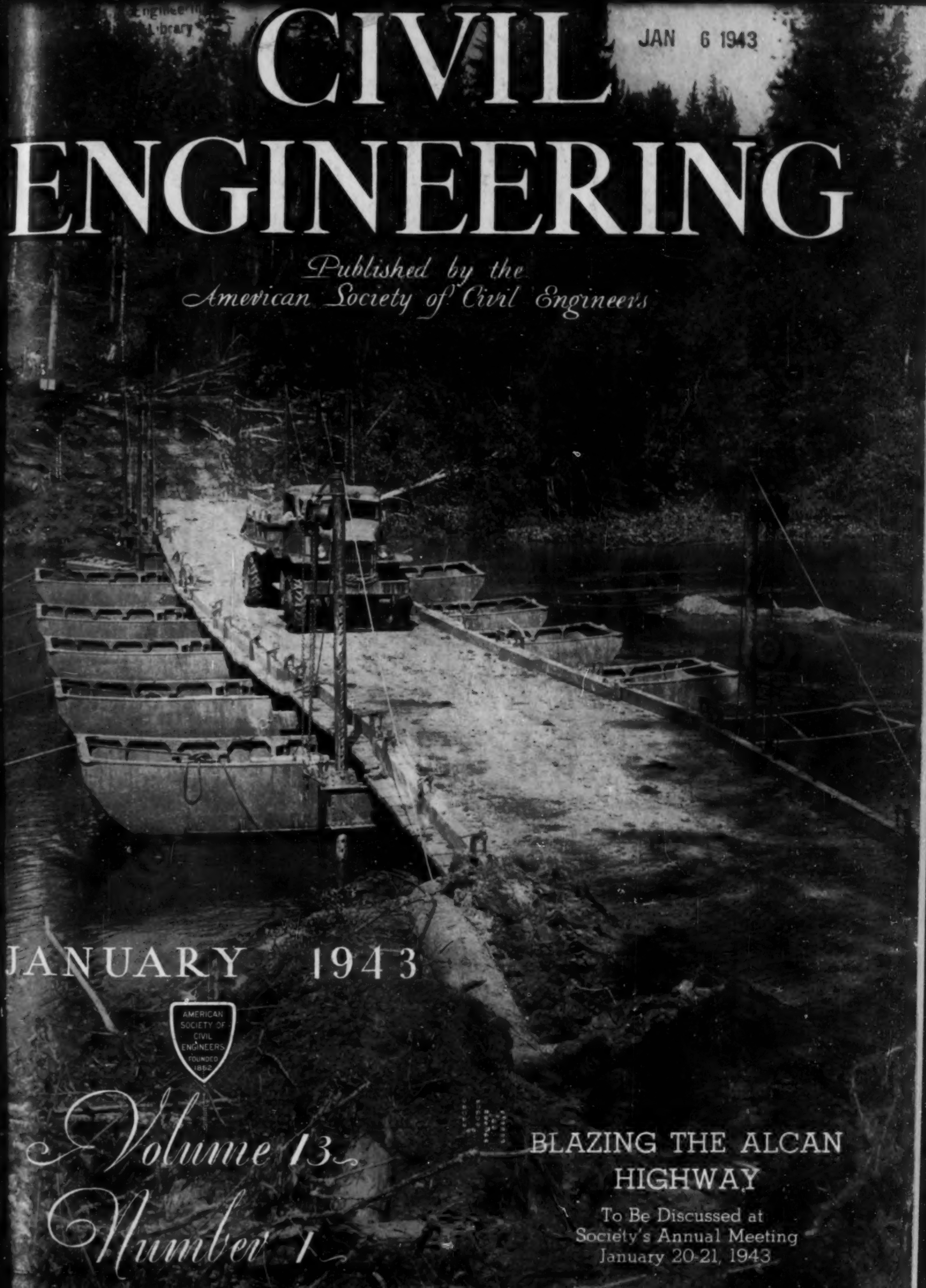

BLAZING THE ALCAN HIGHWAY

To Be Discussed at
Society's Annual Meeting
January 20-21, 1943

Courtesy Ft. Belvoir

TANK CHARGE ARRESTED

Barricade Erected by Army Engineers at Fort Belvoir Successfully Stops an M3 Tank. See Page 3

Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Why Are You Going to School?

From a Talk Before the Engineering Students of the Agricultural and Mechanical College of Texas

By Roy M. Green, M. Am. Soc. C.E.
President and Manager, Western Laboratories, Inc., Lincoln, Nebr.

WHY are you going to school? No doubt you as an engineering student have asked yourself this question already. I hope you have not answered it in a purely mechanical way, saying to yourself that it is "to become just another cog in the machinery." It is my opinion that the profession has always had a very high standard of what it should be; one that is high enough to embrace the qualifications necessary to solve the problems of this age. The correct solution should preserve the right of the individual to work out his own destiny without the control, imprint, and stamp of approval of any so-called "Leader."

A Notable Inquiry.~To get some conception of what the members of your profession have believed, let us go back some twenty-five years and take a look at Prof. C. R. Mann's report on the "Study of Engineering Education." At that time a large number of engineers were asked what characteristics and training the engineer should have. There were approximately 7,000 replies. A summary gives the following composite opinion of the profession regarding the desirable characteristics, to the degree indicated:

Character, integrity, responsibility, resourcefulness, initiative	41.0%	
Judgment, common sense, scientific attitude, perspective	17.5%	
Efficiency, thoroughness, accuracy, industry	14.5%	
Understanding of men, executive ability	14.0%	87.0%
Knowledge of the fundamentals of engineering science	7.0%	
Technique of practice and of business	6.0%	13.0%
		100.0%

This of course does not mean that without a knowledge of the fundamentals of engineering and the technique of practice you could still be an engineer. However, according to this summary—and I believe that the profession is of the same opinion today—the fellow who is studying engineering to be a "cog in the machinery," just to get a job, is preparing himself with only about 13% of the equipment necessary to be a really good engineer.

Always Improving.~The methods of doing engineering work have gone through more radical changes in the past 25 years than in any other period of history, and there is no reason to believe these changes will not continue with even greater rapidity. For example, a student 25 years ago studied reinforced concrete as only a budding science in the United States; the term water-cement ratio was unheard of; no quick-hardening cement had been used on construction work; the science of soil mechanics had not been critically studied; emulsions were not generally used in construction; the first activated-sludge sewage disposal plant had not been built; the present utilization of high-pressure steam was impossible; and the miracles of practical aviation and radio were considered either a dream or the ravings of a lunatic.

Manifestly, no man could practice engineering today if he went to school 25 years ago and had learned nothing of engineering science or its technique of practice afterwards. Twenty-five years from now are you going to have a real knowledge of engineering science and the technique of practice? If you do, it will certainly not be because you passed your course in surveying, reinforced concrete, heat-power engineering, or electric motors; rather it will depend largely upon what you developed within yourself while preparing to pass these courses.

But remember that even after you have this knowledge of the engineering sciences and the technique of practice you have only about 13% of the necessary equipment of an engineer, according to the standard set up by your profession. The remaining equipment is by far the more important. Without attempting to discuss all the necessary attributes, I would like to point out the importance of developing a scientific attitude, perspective, thoroughness, and industry.

Industry.~It is generally conceded that anyone graduating from a course in engineering must work, just a little. It certainly does not follow, however, that only industrious men graduate.

There is a common idea that if a man is brilliant, or smart, he will be a credit to the profession and himself without any great amount of hard work, or at least he

will "get by." This is a very unfortunate way of thinking, for it is a sad state of affairs when a man of unusual mental capacity is satisfied to do only as well as one of poorer natural ability. Such a man is a wanton waster, a squanderer of the world's resources, besides being just plain foolish. By laziness such a man has killed his opportunity to contribute to the good of his profession.

Thoroughness.—The habit of thoroughness is not always encouraged during the pursuit of an engineering degree. As engineering courses are now organized, it is rather difficult for a student to thoroughly digest all the facts presented to him, even if he applies himself diligently, which he does not always do. I have observed that students generally, if unable to comprehend some detail of the text near the beginning of an assignment, will simply skip it and go on. This absolutely interferes with the orderly development of the substance of a course, besides being a very bad habit. For your own good, it is far better to do only part of your work and do it completely than to hop, skip, and jump and only get a vague idea about it. Likewise, it is better to take fewer courses and do them thoroughly.

Perspective.—Perspective is the ability to comprehend a whole system, a whole enterprise, or a whole activity and to properly appraise the importance of its elements. This is a rather difficult thing for students to do because they are too near physics, chemistry, mathematics, and English to be able to see engineering. Without the ability to visualize a whole enterprise and properly evaluate its units, no engineer can hope to do work of any consequence.

You may feel that this discussion of perspective is purely academic, that there is no present opportunity to view the whole and appraise the parts. I would ask you to look at your present round of activities. You have your studies, your picture shows, your school activities, your friendships, your fraternity, and probably some athletics. Twenty-five years from now, what will you have gained from these various things? The picture shows will have left no impression. Ninety-five out of a hundred of you will not care whether or not you belonged to a fraternity. Your friendships should leave a pleasant memory, and your school activities or athletics should make a small contribution to your total store of experience. But without the training of your studies you will not even be prepared to start on your life's pursuits. Perspective means the ability to put first things first.

In studying, how many of you after completing an assignment, have laid your work down and picked out in your mind the central idea or principle involved in it? Try this. Try appraising all your activities.

Scientific Attitude.—The scientific attitude is the willingness and courage to gather together all the facts that relate to any matter, to properly analyze those facts, and to undertake action based upon them. This should be done courageously for, if a false conclusion has previously been acted upon, that conclusion must be abandoned and the new more truthful conclusion put into operation. The study of engineering should certainly teach the folly of attempting action on unfounded opinion. The scientific attitude certainly would not countenance making changes in procedure just because it was popular or because any man or group of men wanted it. Changes would only be made because the new action reflected a necessity shown by newly found and more accurate information. The new problems of this age of power demand men with the scientific attitude.

We cannot dwell long upon the homely virtues of character. But remember! Your profession attaches more significance to them than to any other part of your equipment.

Working with Others.—Your profession also says that you should understand men. If you understand men you can get their cooperation, and as the saying goes, you can handle them. In order to handle men, of course, you must be liked by them. I am sorry to say that few men, when they have just come out of college, are well liked by those they work with. There are, of course, a few exceptions to this, but the general run of college graduates have to have the college knocked out of them before they are very useful.

As a former student, a former teacher of engineering students, a former employer of young engineering graduates, and a co-worker with young engineers, I have a feeling that this difficulty is created by the false notion that you are attending the best school in the United States, that the organization you belong to is the best in the world, that you are prepared to do the world's work when you graduate, that you are superior to other men.

I have heard young men tell their co-workers about their preparation and training, and their manner showed their belief in its superiority. If you are superior, show it only in your work. The people with whom you work are not interested in where you are from, where you are going, what you have done, or what you belong to. It is a fine thing to have a feeling that you are superior, if you are, but please be sure to keep this as a secret within yourself and do not prattle it abroad.

Whatever your duties are, throw yourself into your surroundings, become identified with your enterprise and community. Fraternize with your associates as much as possible, without, of course, interfering with your effort to become the type of engineer you are striving to be.

To Understand Human Nature.—Some few men seem to have a natural ability to gain the confidence and respect of their co-workers, and we say they are natural leaders. There is no man, I believe, who would not improve himself by a little study of this particular type of engineering equipment. For such a study I would sincerely recommend the book, *Human Nature and Management*, by Ordway Tead (McGraw-Hill Publishing Company).

Again I ask, Why are you going to school? This has always been and it always will be a constantly changing world. The practice of engineering is a constantly changing endeavor, and it will no doubt undergo greater changes in the future than it has in the past because of its growing importance in the economic, political, and social structure of the world. It must be obvious, then, that you must prepare yourself not solely by obtaining the facts of engineering science and technique, but especially by developing within yourself the power to go further and change the technique to conform to the new demands of a changing world. If you develop this power within yourself your training will be of untold value in whatever walk of life you may choose. If you do not, you will be just another "foul ball."

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Training and Operations of Engineer Troops

Modern war techniques have rendered useless the type of engineer soldier once tritely described as "a strong back and a weak mind." Greatly expanded use of mechanical equipment and the high speed of military operations over large areas require that every man be trained to act on his own initiative. The use of paratroops and armored columns makes it imperative that every man be taught to fight even though his usual task be to draw maps or operate grading equipment. In addition, the establishment of airfields at advanced positions requires skillful coordination of the construction forces. In the two articles that follow, General Marks deals particularly with the training carried on at Fort Belvoir, while General Godfrey discusses the vital role of the Aviation Engineers in actual battle areas.

Training Officers and Men at Fort Belvoir

By E. H. Marks, M. Am. Soc. C.E.
Brigadier General, U.S. Army; Commanding General, Fort Belvoir, Va.

With the passage of the Selective Service Act, the Corps of Engineers was assigned two training centers, Fort Leonard Wood and Fort Belvoir. After preliminaries were completed, involving assembly of commissioned and enlisted instructors and necessary construction, operation of the Replacement Training Center at Fort Belvoir started in March 1941, and since that time has continued at high speed and full capacity.

The center is so constructed that the barracks area is centrally located, with routes to the various types of training areas radiating from it, so that a minimum of time is consumed in marching to and from work. Equipment for a particular type of training is kept in the appropriate training areas and maintained by a small overhead group.

Several methods of instruction are used throughout the course. Excellent training films, prepared by the War Department, cover a large variety of subjects; also suitable film strips are available for use in illustrated lectures. These methods of visual instruction are supplemented by practical work in the field, the men being rotated during a day's instruction in the different parts of a particular job.

Many educators have visited our training center and expressed great surprise over the varied types of instruction and over the relatively small groups to which instruction is given. Yet nothing is taught that a soldier is not likely to encounter in his war service, nor is the trainee bored through repetition of instruction, for few tasks are repeated.

Men come to us direct from reception centers where, during a period of several days, they have been issued uniforms, given physical examinations and certain intelligence tests, and classified into one of the branches of the service. On our call, based upon availability of space, groups selected for engineers are sent to us from the various reception centers in the eastern United States.

Upon arrival at Fort Belvoir, the men are grouped into battalions of about 1,000 men each. Some of these battalions are for white men and some for negroes. It takes three or four days to assemble and organize a battalion, verify classification, issue personal equipment, and give a day or so of preliminary training so that we can always start a training group on a Monday.

The battalion is subdivided into four companies, and each company into four platoons. The platoon constitutes the training unit. It consists of a lieutenant, with a sergeant and three corporals to assist him as instructors, and about 60 trainees. This comparatively small unit is, when practicable, broken down into smaller groups for certain types of instruction.

Pneumatic Ponton Bridge in Process of Construction by Corps of Engineers Trainees
Courtesy Fort Belvoir

Courtesy Fort Belvoir

A Lesson in Demolition—Instructor Tying Fuse to a Cutting Charge

The full course extends for 12 weeks. Although the schedule is based upon a 44-hour week, it is necessary to spend additional time on administrative procedure and also in special instruction, when it appears that the men of a platoon are not making sufficiently rapid headway. The first 4 weeks of the 12 are known as basic training. This phase of instruction is identical, not only for all engineers, but for other training centers throughout the country for the Quartermaster, Signal, and other branches which make up the Services of Supply. The subjects cover the care of clothing and equipment; tent pitching; defense against chemical, air, and mechanized attack; infantry drill, including scouting, patrolling, and guard duty; first aid; physical training; personal hygiene; rifle marksmanship; preliminary field fortification and demolition; marches and bivouacs; elements of army organization and military courtesy; other general administrative subjects; and orientation lectures on the war.

RANKS FORM AT SIX A.M.

Perhaps the description of a typical day in this early phase of the training may be of interest. The bugle first blows at 5:45 and by 6 o'clock the trainees must be dressed and in ranks. Following this a period of 15 minutes is given for a general cleaning up of the barracks area. Breakfast is served at 6:30. From 7:15 to 7:45 some type of physical training is held. From 8 to 8:50 a training film on close-order drill is shown, after which there is a 10-minute break. This is followed by 50 minutes of practical work in the early phases of close-order drill. Following another 10-minute break come 50 minutes of a practical lesson in military courtesy. Then comes a third 10-minute break, followed by a training film on the Articles of War, which lasts for 45 minutes. This takes us to within a few minutes of noon, when dinner is served. From 12:45 to 2:35 instruction is given in the care of equipment, the rolling of packs, pitching of shelter tents, and the display of equipment. From 2:45 to 3:35 one of seven orientation lectures is given on the background of the present war. After a 10-minute break there is a three-quarter-hour period of close-order drill, which is a logical development from that given in the morning. The retreat formation is at 5:30, when the flag is lowered, and immediately thereafter supper is served. Except for occasional administrative duties, the soldier will have the evening to himself. He may attend a current moving picture or, on certain nights of the week, a dance in the Service Club. He may play table tennis or other games in his battalion recreation hall, or visit the Post Exchange. At 11 o'clock taps is sounded and a bed check is made. So much for the typical day in the life of a trainee.

Upon the completion of the first four weeks of training, the men pursue instruction devoted mainly to combat work and engineering. The subjects covered are the use of the bayonet, combat for small units, demolitions, Engineer reconnaissance, field fortification, fixed bridges, floating bridges, general construction, knots, lashing and rigging, machine guns, obstacles, roads, tools and equipment, and night operations. During this part of the course, there is no repetition of any task. For example, the subject of demolitions is given in 7 lessons of 4 hours each. Each lesson is different and progresses from such a thing as the insertion of a cap into a stick of explosive, up to the proper way to blow up a steel bridge.

Each lesson to be taught must be thoroughly prepared in advance by the instructors. The instructing officers and non-commissioned officers assemble for night classes before any subject is undertaken, and the scope of the work is reviewed. The instructors are required to plan the work so that the necessary tools and materials will be at the site when the instruction period arrives. The platoon commander is responsible for the instruction of his platoon in all subjects, but we maintain a very thorough system of supervision through our headquarters training section.

In the early or basic part of the course the periods of instruction are relatively short. In the later phases, however, it is normal, after a 30-minute period of close-order drill or calisthenics early in the morning, to spend the remainder of the day in some one of the various training areas on a specific task, such as the building of a trestle bridge.

COMPETITIVE SPIRIT FOSTERED

In all these tasks, we try to give a practical illustration of the end the men are working to accomplish. Just as soon as a bridge for vehicles is finished, a truck or tank column speeds across it. Men who have built a tank block see a tank rush it at high speed in an attempt to break through. Incidentally, this procedure creates a highly competitive spirit, evidenced by spontaneous cheers when the tank is halted, as it usually is.

Upon conclusion of the 12 weeks of training, the men are shipped as individuals to various regiments in the United States, or possibly to some of the task forces. This clearing-out process takes about a week, during which time the training battalions refurbish their supplies and equipment. After one group of 1,000 men has moved out, another group of 1,000 begins to filter in, and the training process is repeated.

We can by no means claim that when a man leaves the Training Center he is a thoroughly trained soldier. His

Courtesy Fort Belvoir

Up But Not Over! Fort Belvoir Engineers Stop a Plunging Tank

physical condition has been greatly improved, he is a much tougher individual, but he has merely obtained training as an individual. After he has joined an organization, the training must continue in order to get the teamwork that efficient organization demands. He must be trained in cooperation with other arms of the service and in the maneuvering of large bodies of men.

The great need of Engineer units for specialists has necessitated the curtailment of the previously described training for a considerable percentage of our men. We had hoped that civil training would produce most of these specialists, but the numbers required were such that our hopes were not realized. In order to meet the deficiency, at the end of 5 weeks of training, about 40% of the men especially selected on account of their experience or aptitude are sent either to special schools operated by the Army or to universities or trade schools which have contracted to furnish this service for the Army. For example, at Fort Belvoir we operate special schools for training in the operation of water-purification equipment, in map reproduction, and in photo-topography. The type of training afforded by some of our universities and trade schools is exemplified by that at the University of Kentucky, where special courses in surveying and drafting for soldiers have been instituted.

Still another group of selected men, after seven weeks is given specialist training within our own Training Center. The specialists turned out include truck drivers, heavy-equipment operators, construction foremen and carpenters, mess sergeants, bakers and cooks, and clerks.

If time permitted, it would be far preferable for all men to take the complete course of 12 weeks before undertaking the specialist training, but the exigencies of the war dictate otherwise.

PRE-INDUCTION TRAINING

This present situation is to be relieved during the next few months by the institution of specialized pre-induction training. This training is planned by the Services of Supply of the Army, to be administered by the Office of Education. The directive recently issued states:

"The pre-induction training program will increase the supply of trained men, thereby reducing the amount of training needed after induction into the Army. The Army would then be free to concentrate upon post-induction training in the combat applications of the various technical specialties of modern warfare."

The problem of training a certain percentage of men who are illiterates, have some physical defect, or are of subnormal intelligence must also be faced. These men are placed in special units, and their training requires a

Courtesy Fort Belvoir

SECURING THE BALK TO THE PONTON BOATS FOR A HEAVY BRIDGE

Courtesy Fort Belvoir

COMPLETED FOOTBRIDGE IN SERVICE

great deal of patience and care. Take, for example, the case of one illiterate trainee who combined his illiteracy with a marked degree of akwardness and ineptitude. He was a white boy from the backwoods of Georgia. The usual line of questioning to find out just what he might be able to do, brought forth very unsatisfactory answers. The man had no conception of the war situation, or why he had been drafted. Finally, in desperation, the questioner asked, "Who is President of the United States?" The Georgia boy thought a long time and then timidly replied, "It wouldn't be Eugene Talmadge, would it?"

So rapidly has the Army expanded that the two Engineer centers have been unable to meet the demand for basically trained Engineer soldiers. As a consequence, many organizations are forced to train their own men without the assistance of the training centers.

Men find the work interesting, and because they are busy, their morale is high. The living conditions are excellent and, in addition to the recreational features in the typical day of a trainee which I have been mentioning, there is an art project, in which a number of men with excellent artistic ability are producing murals for our recreation halls. On Sundays a program is broadcast—written, produced, and played by the men at Fort Belvoir. A local newspaper and an excellent magazine also enable those with talents to find some outlet for them in their spare time.

OFFICER TRAINING

In the fall of 1940, the Engineer School at Fort Belvoir, which has functioned for many years in training officers of the regular Army, the Reserve, and the National Guard, greatly increased its capacity by shortening courses and increasing the number of students. Instructor courses of six weeks' duration were initiated. Later several other types of courses were instituted. These comprised refresher courses for R.O.T.C. graduates, special courses in camouflage, special courses in the operation of mechanical equipment, and courses for senior officers.

It is even more important for officers than for enlisted men that those entering any possible theater of operations be trained to fight, to execute hasty military works, to read maps, and to know the principles of military administration, supply, court-martial procedure, and other essential subjects. Of necessity, many expedients have been adopted to give such training to a greater number of engineer officers than could be handled at the Engineer School. For some special regiments, most of the officers were drawn directly from civil life. Some hundreds of these were sent to the Fort Belvoir Training Center for a four-week course in essential military subjects. The methods of visual instruction, conferences, lectures, and

Courtesy Fort Belvoir

A FOOTBRIDGE OF LIGHT UNITS IS QUICKLY BUILT

practical work were followed. Similar courses were carried out at Fort Wood. These types of courses have now become routine for practically all officers called from the Reserves or drawn directly from civil life, and are given at many locations where new officers are assembled.

More than a year ago it was obvious that the Officers' Reserve Corps and the R.O.T.C. could not produce the needed numbers of officers for the Army then in sight. Moreover, a means for enlisted men to develop into officers, although desirable, was non-existent. The officer candidate system was therefore introduced in a modest way in the summer of 1941, when at the Engineer School the initial class of 100 men was assembled for a three-months' course. The greater demand to fill the needs of task forces and armies since Pearl Harbor has put a tremendous load on officer candidate schools. Today we are taking in classes every two weeks for a 12-week course, and are commissioning many hundreds of officers every two weeks. This system is the principal source of Engineer officer supply.

All the officer candidates are selected from the ranks of enlisted men. From the moment the trainee joins the Army, notation is made of his educational and practical experience, and he is given every opportunity to display qualifications of leadership. Upon the completion of three months of training as a soldier, every man is afforded the opportunity to apply for the officer candidate class. He appears before a board, which examines into his educational qualifications, experience, character, physical condition, and most important of all, ability as a leader. Quotas for officer candidate classes are assigned to training centers and tactical organizations of all branches of the service. It is not easy to fill the quotas with properly qualified men. While a full technical education is not essential for junior Engineer officers, they must know at least a little bit of mathematics and have some knowledge of construction principles. This makes the course very difficult for those who have had no experience as an Engineer soldier, but with proper educational background they should not fail.

PLATOON IS THE INSTRUCTION UNIT

The students in the officer candidate school are organized along the same lines as in the Training Center; that is, the unit of instruction is the platoon, which, however, is smaller than in the Training Center. Platoons are grouped into companies, companies into battalions, and battalions into regiments. Officers designated as tactical officers command each platoon, handle administration, some types of instruction, and observe the individuals closely throughout the course, particularly as regards leadership qualifications.

There is also a large faculty, the duties of which are solely in the field of instruction. In this respect, the training of officers is different from that of enlisted men. A little less than 50% of the time of the officer candidate is spent in practical work and exercises, a much smaller percentage than is spent by the enlisted man. The bulk of the time is devoted to demonstrations by trained troops, conferences, lectures, class problems, moving pictures, and examinations. Quizzes are held at the end of every course, or at the end of every important subdivision of a course. These are graded, and if a man fails to obtain a reasonable degree of proficiency in several subjects, or if he has not demonstrated qualities of leadership, he may be removed from the school, or may be placed in a development group to make up the deficiency and join a later class.

The subjects covered in the candidate classes are much the same as I have indicated for trainees, except that the approach is from the standpoint of teaching others. For example, the officer candidates do not take a regular rifle course to qualify them as expert shots, but are told how to teach others, and spend more time on the methods, devices, and theories of producing qualified shots. In addition to the subjects covered by trainees, there are several subjects which they, as officers, must know. These cover Army organization, military law, company management, training methods and management, rail and truck movements, and other administrative subjects. The officer candidates are given a broader view of tactics than is given to the soldier.

Naturally, the candidates are the pick of all the soldiers who have developed leadership qualities and have had a fair education. Almost without exception, they pursue the course with vim and enthusiasm. They have a definite mission and know it. They are ambitious, present a fine appearance in ranks, and work hard. In addition to a scheduled 48 hours per week of instruction, there are ten hours a week of supervised study and a few hours of exercise.

Upon completion of the 12-week course, formal graduation exercises are held, at which time diplomas and the eagerly awaited certificates of appointment as second lieutenants are presented. The newly commissioned

Courtesy Fort Belvoir

STUDY HALL AT FORT BELVOIR
Rapid Schedule of Officer Training Requires Concentrated Effort of Candidates

officer may be assigned to any type of Engineer duty—the large majority join Engineer regiments.

CANDIDATE SELECTION THOROUGHLY DEMOCRATIC

Candidate instruction has been in progress for a sufficiently long time, and enough reports have been received from the field to indicate that the product from the Engineer School is most highly thought of by the Army. The candidate system is in force in all but a few highly specialized staff branches. It is a very democratic system in that every soldier has a chance for a commission, and in that those obtaining a commission will have served in the ranks. Officer products of the system will have had at least six months of intensified training in the military service. This present system will beyond doubt amply justify itself in the test of battle.

The morale of trainees and officer candidates at Fort Belvoir has always been very high, and exceedingly so since Pearl Harbor. In this and similar training centers a healthy attitude is due in large measure to the amount and character of the work given the men. Nevertheless, when the men are sent abroad to strange countries and unfamiliar surroundings, and possibly meet some reverses, they must know that the country is united behind them.

Our growing army has attained a considerable size, and a high degree of efficiency. Full efficiency will be achieved through the experience of actual combat with the enemy. But neither numbers, nor efficiency, nor those two combined, can bear full fruit without the highest morale and a clearly visualized objective, not only in the armed forces, but amongst the people. Those of you here at home must continue to take an obvious pride in your Army. Every suitable action should be taken to let the soldiers know that you are behind them, and that you are united with them in keeping the common objective steadily in view. That common objective is the complete victory of our armed forces.


Courtesy Fort Belvoir

TRAINING IN ASSAULT-BOAT CROSSING AT A BRIDGE SITE

Engineers with the Army Air Forces

By STUART C. GODFREY, M. AM. SOC. C.E.

BRIGADIER GENERAL, U.S. ARMY AIR FORCES

"AMERICA'S Alaskan force last week had all but won the Battle of the Aleutians, and the reason therefor was simple. We have air bases in the islands and Japan does not."

Thus John Norris, writing for the *Washington Post* in September, sums up the improved situation in the Aleutians. Earlier in June, as he states, the existence of an airdrome for land-based planes, close to Dutch Harbor, had upset the plans of the Japanese force which struck savagely at that Naval base. This landing field had been secretly built some weeks before, its initial runway being a quickly laid transportable steel landing mat.

In September a force of transports and barges, protected by warships and planes, moved several miles westward to an island in the Andreanof Group, of which they took possession. "Here again," says Mr. Norris, "the Army Air Force engineers proved their worth." Within five days a runway was ready for fighter planes. A week later, four-engined bombers were taking off from the new landing field to operate against Kiska.

This is one illustration of many that could be cited, of the vital importance of airdromes in modern war. General Arnold, who commands the Army Air Forces, thus expressed the need in addressing a group of the Society of American Military Engineers in October 1941:

"Finally, and this is where the military engineer enters the picture, air bases are a determining factor in the success of air operations. The two-legged stool of men and planes would topple over without this equally important third leg. Hitler failed in his attempt to destroy the R.A.F. largely because the engineers had provided England with a wealth of camouflaged, easily repaired, and widely dispersed landing fields which offered a hopelessly decentralized target and enabled the R.A.F. to keep its fighters almost continuously in the air. On the other hand, you know what happened to the R.A.F. when it lacked airdromes in Crete."

Our own Army has not been slow in recognizing this need, and some three years ago initiated the formation of Aviation Engineer troop units, a component of the Corps of Engineers, assigned to the Army Air Forces. For an air force, like an infantry division or an armored force, needs its own engineers—troops who have trained with it intimately, who speak its language and understand its needs. And these troops must have special equipment and special training for the task.

THE TASK OF AIR FORCE ENGINEERS

This task, in brief, is to build advanced airdromes in a hurry. Aviation engineers must be ready to construct or reconstruct military airdromes, or improve existing ones, in the shortest possible time. They must be skilled in the camouflage of airfields, and the construction of defensive works. They must be organized and prepared to repair instantly fields damaged by enemy bombing. Finally, with their trained riflemen and machine gunners, they must be prepared to take an active part in the defense of airdromes.

To visualize a military airdrome in war, we need to differentiate it sharply from the usual commercial airport or permanent peace-time Air Corps Station. The latter offers a conspicuous and vulnerable target to enemy bombers. By great effort it can be rendered less conspicuous. But preferably, an air force will operate from smaller auxiliary fields. Such fields lend themselves better to camouflage. Planes on the field, instead of being huddled on a parking apron, are dispersed in

MODERN MECHANIZED EQUIPMENT ASSISTS AVIATION ENGINEERS SPEEDILY TO CONSTRUCT ADVANCE AIR FIELDS

pens around the field or in adjacent fields, made accessible by a taxi-track. Servicing installations are simpler and are also dispersed and concealed.

The first requirement of a field airdrome, obviously, is an adequate landing and take-off area, which may vary from a single turf strip to an elaborate system of hard-surfaced runways. For the modern heavy bomber, with its increasing weight, the hard-surfaced runway is becoming almost a necessity.

The conventional geometrical runway patterns of our permanent air bases have no place in the field airdrome, in laying out which much attention should be given from the beginning to concealment and camouflage. Runway strips should be contiguous but preferably not intersecting, and the clearing designed to give adequate width to landing strips should not extend to the whole area.

Equal in importance to the runways are the taxi-ways which permit their full utilization. These paved strips, constituting a "perimeter taxi-track" or the equivalent, give convenient and speedy access to the ends of runways from the areas where the aircraft are parked.

The vital need of dispersing airplanes on an airdrome no longer needs to be demonstrated. This requires hard standings around the landing area, or in adjacent fields, with the maximum of concealment, and often protective pens or "revetments." These splinter-proof pens offer protection against shell fragments resulting from high-level bombing; they do not protect against low-level strafing.

A second requisite for every operational airdrome comprises the essential facilities for serving the planes, with storage for gasoline, ammunition (bombs and small arms ammunition), and chemicals. In the field, reliance must often be placed on dispersion and concealment of gasoline tanks, instead of the underground storage provided at air bases. Bombs will be stored in dispersed storage piles, protected by splinter-proof revetments. Large, elaborate hangars present an attractive target, yet since overhead cover is required for major repairs, one simple steel-frame hangar will usually be provided to house only those planes that are under repair. Light, power, water supply—the need for these facilities is obvious.

The operations building with its communication facilities, nerve center of the airdrome, is so important as to deserve protection against small-arms fire and bomb splinters. Other administrative buildings are relatively less important, and the personnel in them can take cover in air-raid shelters conveniently located.

Except for personnel on 24-hour duty on the airdrome, all living, messing, and recreational buildings should be well away from the landing field. One satisfactory solution is to group the messing and recreational facilities at one site, perhaps half a mile from the landing field, with living accommodations in organizational groups some hundreds of yards from this communal center.

Defensive installations may be of many types. Elaborate concrete pillboxes and other works arranged around the perimeter of a landing field tend to be conspicuous and to attract bombing. The tendency is toward simpler field works, camouflaged with utmost care. Obstacles to block hostile approach, and plans for the demolition of the airdrome, in case its capture becomes imminent, are also engineer tasks in the defense.

Camouflage of an airdrome, though mentioned here at the end, is something that must be planned from the beginning—in layout as well as technical treatment. Sometimes it must suffice merely to render an airdrome less conspicuous by reducing contrasts and blurring outlines. Sometimes the airdrome may be made to resemble something else—its runways disguised by false roads and hedges and other patterns. And finally, resort may be had to constructing a dummy airdrome some distance from the real landing field, to draw the enemy away from the target he seeks.

ORGANIZATION AND EQUIPMENT OF AVIATION ENGINEERS

The Engineer Aviation Battalion is the basic engineer construction unit of the Army Air Forces. It was organized to provide 24-hour-a-day operation of its equipment. The battalion is designed to be capable of independently constructing an advanced airdrome and all appurtenances.

AN IMPORTANT OVERSEAS FIELD SURFACED WITH TRANSPORTABLE STEEL LANDING MAT

Largest unit is the Engineer Aviation Regiment, consisting of a Headquarters and Headquarters Company and several battalions. Battalions are identical with the regular Aviation Engineer Battalion and they are capable of independent operation. The Headquarters Company has heavy equipment not contained in the battalion. This unit is designed to perform a large volume of work in a fairly concentrated area.

A recently formed type of unit is the Airborne Aviation Engineer Battalion. The unit and all its equipment are designed for airborne operations. It is capable of taking over and putting in operating condition captured enemy airdromes, if need be those seized by other airborne troops behind the line. This light equipment and organization also fit it for landing operations.

A specialist unit of the Aviation Engineers is the Engineer Aviation Topographic Company. This unit functions in the making of aeronautical and target charts from aerial photographs taken by the photographic groups of the Air Force. It works in tandem with the photographic group and is provided normally on the basis of one company per photo group.

A few Engineer Aviation Camouflage Battalions are provided to furnish technical assistance, supervision, and control for the camouflage activities of all Army Air Force units in a theater of operations. An Engineer Headquarters Company is attached to an Air Force Headquarters and performs necessary drafting, designing, surveying, planning, and coordination in connection with the activities of the Aviation Engineer units under the Air Force.

The Chief of Engineers has spared no pains to make the equipment for aviation engineer units as complete and adequate as possible, without at the same time overburdening the troops. Thus, general-purpose construction equipment was preferred to more efficient, but specialized machines. Even so, the separate aviation battalion has no less than 220 pieces of heavy equipment, and 146 vehicles. This heavy equipment includes such items as diesel tractors with bulldozers, carry-all scrapers, auto-graders, gasoline shovels, rollers of several types, concrete mixers, air compressors, trencher, well drill, and the like, with numerous trucks and trailers. Moreover, sets of additional special equipment—asphalting and concreting equipment, rock crushers, draglines, pumps, and the like—are provided for use if and when needed, as in case of overseas task forces.

Camouflaged Airdrome in Recent Maneuvers Proved Highly Successful

It should be stated that there is no thought that all airdrome construction in a theater of operations will be done by aviation engineer units. The latter are intended primarily for "pioneer" work on the more advanced airdromes, where speed is essential and the utilization of existing facilities or improvisation of new ones is indicated. The more permanent base airdromes in rear areas, built more deliberately and with greater refinement, are likely to be the work of engineer general service regiments. These latter units, and combat engineer units as well, may expect at times to have some phase of airdrome construction included among their many tasks—special equipment in these cases being furnished therefor.

One tested device that makes for speed is the transportable steel landing mat. Several types of prefabricated sectional runways have been tested and found more or less satisfactory to serve in lieu of paved runways. The mats that have been found most suitable are neither light nor inexpensive; the materials for a single runway may weigh some 2,000 tons. However, the preparation of a runway, under suitable conditions, can thus be reduced from weeks to a matter of days.

There is a definite need for two types of landing mat. The emergency or light type is strictly a field expedient. It is designed to provide more or less temporary runways for pursuit and observation planes at advanced airdromes; it can be used for taxi-tracks and hard standings at any airdrome. The heavy-type landing mat is more than an emergency landing surface. Rather it provides a rapidly laid, semipermanent runway which, if placed on a reasonably stable foundation, and carefully maintained, will provide fairly satisfactory continuing service for all types of planes.

Several types of mat, of varying weights, have been tested and adopted as acceptable for various purposes. Millions of square feet of steel mat have now been shipped all over the world, and almost every theater provides instances of its successful use. The Engineer Board, under the Chief of Engineers, deserves credit for the successful development of this mat over a period of the last three years.

Specialized Training Activities

Aviation Engineer units are in general organized and receive their training at Air Corps stations, where they acquire familiarity with Air Corps requirements and operating conditions. They are not, in general, employed in the air-base construction program being executed by the Construction Division, Corps of Engineers. But in many cases they have undertaken some definite tasks in this program, such as the construction of soil-cement and asphalt parking aprons and roads, hard standings, and revetment pens. They have assisted in the development of steel landing mats, and of the best technique for airdrome camouflage. They have constructed experimental runways using various types of construction.

At maneuvers in the fall of 1941, aviation engineers first demonstrated their value to the Army Air Forces under field conditions. As General Arnold said in this connection, referring to the maneuvers in Louisiana in September: "Few airdromes were available. Many of these needed work on runways, taxi-strips, parking areas, access roads, and removal of obstacles—a task which was carried out impressively. As a secondary task, the engineers performed highly successful duties in the concealment of airdromes and aircraft and in shelter and defensive works for men and planes. Splinter-proof barricades, camouflaged runways, and false hedge-lines were a new sight to many of our pilots, and gave convincing proof that a vital part of air force operations is in the hands of an organization that is on its toes."

Later, during the Carolina maneuvers in November, the 2d Battalion of the 21st Aviation Engineers constructed the first field airdrome in the continental United States with a runway of transportable steel plank, laid in a matter of days, including grading. It was used by many types of planes, among them heavy bombers.

The camouflage of an airport in the Carolinas by Company B, 21st Engineers, at this same time, was the

first outstanding example in this country of a completely camouflaged field airdrome. The contour ditching of the surrounding terrain was used as a motif and was successfully simulated on a turf field. Ditches and orchards were created by ground painting with cut-back asphalt. Dummy roads were produced by strips of light-colored clay framed by ditches of asphalt.

Recent camouflage activities of Aviation Engineers have not been confined to the fields they build. Every two weeks the Air Force Camouflage School at Hamilton Field, staffed by Aviation Engineers, turns out a large class of officers from all elements of the Army Air Forces who have acquired a practical knowledge of camouflage. This school parallels the course in camouflage given at the Engineer School, Fort Belvoir, Va. Aviation Engineers have been assisting Air Service Groups in operating in the field from concealed bivouacs. In several Air Forces mobile instruction units under the Air Force Engineer are operating from field to field conducting camouflage schools for the non-commissioned officers of the Army Air Forces. Schools in camouflage are being conducted in the Air Forces overseas.

AIR-BORNE ENGINEERS LOAD THEIR SPECIALLY DESIGNED EQUIPMENT INTO A TRANSPORT PLANE

AVIATION ENGINEERS IN WAR

Although a young component of the Army Air Forces, the work of aviation engineers in combat theaters overseas already contributes an impressive record. The following are a few instances that have been released to the press.

Aviation Engineers have built or are building airdromes in Alaska, in Africa, Australia, India, Iceland, Hawaii, Panama, Puerto Rico, the South Seas, and Great Britain. They have built airdromes under the most diverse conditions in almost all the far-flung theaters of this war. They built fields on Bataan and further south in the Philippines—fields that enabled General Royce's bombers to operate until the end of that campaign. The work has been carried on in Australia and New Guinea.

In New Caledonia, Aviation Engineers built airdromes and then brought aviation gasoline for the planes ashore in rafts from a freighter lying in an uncharted roadstead. They had one airdrome built and that gasoline ready in time to enable our Army and Navy planes operating from there to play a decisive role in the battle of the Coral Sea. In one theater an Aviation Engineer officer is building fields with native labor, including several thousand women, who are breaking rock by hand. One of the tasks of the Aviation Engineers is the defense of airdromes. Recently an Aviation Engineer Battalion has performed that task exceedingly well. At Milne Bay in New Guinea the Japs put a strong force ashore, equipped with tanks and artillery, to seize an airdrome being built by Aviation Engineers there. The Engineers joined the Australians in defending the field. After heavy fighting the Japs were repulsed. Reporting the engagement, a United Press war correspondent in New Guinea declared that it was "the hardy engineers who turned the tide of battle for Milne Bay."

An example of excellent airdrome construction other than by aviation engineers was afforded at an isolated tropical island, an important station on a trans-ocean ferry route, where a combat engineer regiment, furnished with special equipment and supplies, started from scratch and built a complete airdrome in about three months' time.

THE PROBLEM OF LEADERSHIP

In the rapid and continuing expansion of the Army Air Forces and their engineer component, perhaps the most acute problem is that of providing adequate leadership and technical knowledge. Few trained engineer officers are now available for new units. Most of the officers are now obtained from the young graduates of the Engineer Officers' Training School, picked primarily for their leadership qualifications. These graduates are commissioned as second lieutenants, after receiving basic instruction in military engineering. But for the most part they lack experience in actual construction work. There is a recognized need for a certain number of more mature officers who are experienced directly in field work—roads, airports, and general construction.

The War Department has recognized this need for experienced officers, and provision has been made for commissioning a certain number from civil life. At the present time, applicants must be between the ages of 35 and 45 years, not in draft classification 1-A, 1-B, or 4-F. They must be in good health, and must have had considerable field construction experience. The Chief of Engineers is assisting in processing such applicants as are desired by the Engineer Section, Directorate of Base Services, Army Air Forces, and coordinating with the Officer Procurement and Appointment Branch of the Adjutant General. Officers so selected receive a month's training in basic military subjects before joining a unit.

The American Society of Civil Engineers can help—is helping—in providing from its membership men who meet admirably these qualifications.

It is also possible that future Selective Service policy may afford inductees some choice of assignment. In any event, all enlisted men in the Army of the United States have the privilege of applying for the Corps of Engineers Officer Candidate School after three months' service. Selection is based primarily on leadership, but technical qualifications are also weighed. Candidates successfully completing the course are commissioned in the grade of second lieutenant. Young members of the Society may therefore hope to qualify for commissions through the ranks in that component of the Army, the Corps of Engineers, which is closest to their profession.

Aviation Engineers are no longer a new type unit. Their numbers are growing steadily, constituting at present many thousands of officers and men. Events have proved the soundness of this provision for assisting the Army Air Forces in their great task. The actual construction work accomplished in overseas theaters is already impressive, and the number of units sent overseas in response to urgent demands attests the vital need for their services. Aviation Engineers, in short, are ready to provide, and to provide quickly, those essential field airdromes without which the most powerful air fleet cannot operate.

Young Engineers, Watch Your Start

Some Words of Practical Advice to Graduates Entering the Construction Field

By Harry O. Locher, M. Am. Soc. C.E.
Secretary-Treasurer, The National Association of River and Harbor Contractors, New York, N.Y.

Because of their nearness to academic halls, and to the more theoretical phases of engineering, students and recent graduates especially need counsel on the "practical" side of the profession. It is to such an audience that this article is chiefly addressed. From his close contact with the construction field, Mr. Locher stresses the value of cooperation between engineer and contractor, and evaluates what is important "on the job."

One of the foremost contractors in the country used to say something like this, "It's easy to get just engineers, fellows who can draw, handle an instrument, do things like that. But to get engineers with initiative and vision, with observing and practical minds, who are good cooperators and who get along well with superiors, associates, and subordinates—that's another story. Without most of these qualifications, few engineers, regardless of how good their technique is, are destined to become outstanding. To succeed outstandingly, an engineer has to be more than a good engineer."

It does not take long for the ambitious young engineer to realize the truth of what this contractor said. He soon finds that these extra qualities are vital in the career he has envisaged. He begins to wonder why certain practical principles and the results of the experience of others were not made available to him during his college years. At the very beginning of his career he finds problems that are not "in the books," which bewilder him completely. Of course many of these practical things cannot be learned in college. However, the student can certainly become familiar with procedures by reading books and articles on construction, and by attending meetings of professional men where such matters are discussed.

VALUE OF VACATION EMPLOYMENT

Vacation employment on a construction job will also teach something about human relations. Few things will help more. Progress can thus be hastened immeasurably. When in the field, the young engineer should study diligently the practical books and articles that relate to his current work.

Many construction engineers have hastened their advancement through the practice of keeping scrapbooks of photographs and articles, illustrating and describing unique uses of equipment and materials. Often, when confronted with difficult or unusual situations, a search through these books will give them a new idea or a combination of ideas which will lead to the quick and economical solution of a difficult problem. Young engineers should lose no opportunity to visit projects under construction, keeping their eyes wide open and learning all they possibly can.

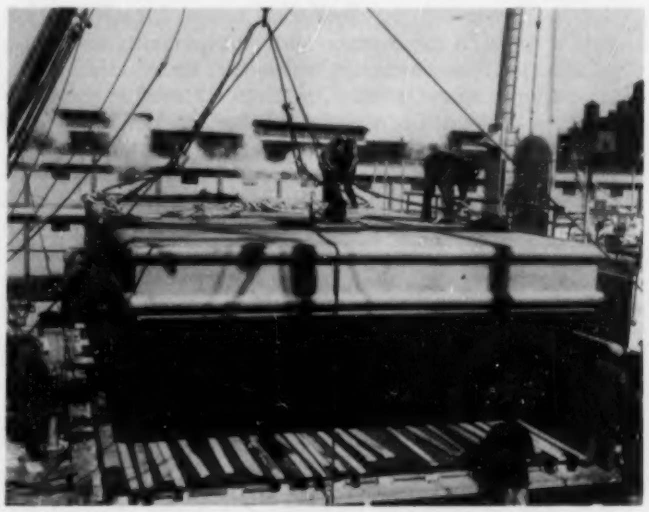
A young subordinate engineer, on a contract involving a hydraulic fill, was instructed to see that the pool was held at a certain level. When the character of the pit material changed sharply, he disdained the contractor's suggestion that he get in touch with his chief and inform him of the changed situation. The contractor, recognizing the necessity of varying the pool level, ignored the engineer. Ill will followed; the work was hampered; costs were increased. Had the engineer been willing to call his superior's attention to his lack of experience and seek his advice, these difficulties would have been averted. When assigned to the hydraulic-fill job, this young man should have sought information concerning similar work. Also, if he had admitted, frankly, that he knew little about hydraulic fills and that advice would be appreciated, it is certain that the contractor would have been helpful to him and taken not the slightest advantage of his ignorance. Cocksure ignorance is invariably the source of much trouble and unnecessary expense.

Young engineers should be told, early, that engineers of many years' experience frequently call on practical construction men to help solve certain problems which never appear in the books. They should understand early, too, that substantial contractors are not always looking for a chance to "put something over" on them; that almost all contractors respect engineers to the same degree that these engineers respect them.

CUTTING RED TAPE

Orders should be executed properly, but when a peculiar situation arises which necessitates change, it reflects no credit on the engineer to follow blindly the original order. It should be possible for requests and explanations to go up the ladder of authority as easily as orders come down. Obviously in such cases, lack of initiative, timidity, or plain obstinacy do not help. This is where common sense is required.

In a recent editorial this statement was made, "Only forthright action by subordinates can cut red tape, and the requisite for that is not an order from the boss but individual courage. Red tape is just another name for established procedure, and cutting it means, in plain language, to flout it, when necessary. Too few persons



Familiarity with Contractor's Equipment Can Only Be Gained by Working with It
Riggers Unloading a Work Scow

EXAMPLE OF A SCRAPBOOK PHOTOGRAPH THAT MIGHT ASSIST IN SOLVING A CONSTRUCTION PROBLEM

Denny Hill Regrade Project, Seattle, Wash., 1909

have what it takes to act first and get confirmation afterward." Judgment which would warrant this initiative must come largely from experience, you say. That is entirely true. If the young engineer had the experience which would justify his making the decisions he would be giving orders, not executing them. It is therefore essential that the inexperienced engineer seek advice when it is necessary to modify the orders he has been given. Thus only can he discharge his duty in fairness to all parties concerned.

PUNCTILIOUS INSPECTION

Akin to this is the inflexible attitude of some inexperienced engineers, and some experienced ones as well, with respect to inspection. In guarding the best interests of the owner, it is not necessary to cause a real hardship to the builder with no additional gain to the structure. Performance of full duty entails an understanding of the objectives to be attained, giving every consideration to practical limitations. If inspection rules can be interpreted to meet peculiar situations economically with no loss to the value or function of the structure, it is to the engineer's credit to make that interpretation.

Pettiness in engineers soon becomes widely known. Men with this characteristic seldom go far in the profession. Engineers are migratory, and the news of men and their work travels widely. Reputations are established or broken in the process. Often a construction engineer finds to his dismay that if he was in wrong on the Atlantic Coast, he is not wanted on the Pacific Coast. He must learn to get work done properly, and at the same time be a cooperator, a team-worker, and a builder of good will. It helps tremendously in his advancement.

On a certain concrete structure, the engineers built up a disastrous amount of ill will between themselves and the contractors by condemning sound plum rock for use in mass concrete because a few drops of grease from derrick sheaves had fallen on it. They also refused the request of the contractor to use local sand, which contained a minute percentage of clay. The cost of manufactured sand was nearly $5 a cu yd. Some years later, it was authoritatively proved that several times as much clay as this sand contained was not injurious to the mix. Actually a more workable concrete of the same strength could have been made with less cement.

Too often young construction engineers begin building their reputations, good or bad, with little thought for their future. Before going headlong into city or state construction work, these young men should look carefully at future prospects, weigh possibilities, and their own probable position ten years hence. Then they should compare that position with a possible one in private industry.

It is all too easy to start in the wrong place. It is still easier to stay there too long. Mature trees from barren soil rarely flourish, even when transplanted to fertile ground.

FIELD WORK ENLIGHTENING

Some graduates gain the impression that most of their future work will be at a desk. Of course, such work is important, but the genuine construction man does much of his work in the field using men, materials, and equipment. Many young engineers know the theory and design of suspension bridges, but relatively few can construct a timber bridge across a mountain stream, using a crew of men with axes, and timber that is felled at the site.

The young engineer should familiarize himself with such practical things as the building of safe spillways in embankments enclosing dredge-dump areas, pointing holes in tunnel-heading rounds, testing new fills before moving heavy earth-handling machines across them, and a variety of other procedures learned through practice. Such things are the construction man's job, you say. But many engineers are training to be construction men, and many more will supervise construction men. Although reading books and articles will not make a student engineer a full-fledged construction man, they can familiarize him with construction methods. The knowledge gained will save him from being a complete greenhorn when he gets in the field.

Today, more than ever before, both quality and quantity in construction depend upon equipment. This is operated by steam, electricity, fuel oil, or gasoline. The student should learn at least some of the elementary,

R. G. LeTourneau, Inc.

OFTEN CREDIT FOR SPEEDING THE WORK GOES TO A MAN WHO KNOWS EQUIPMENT

An Earth Mover in a Highway Cut

practical things about these various types of power. He need not become an expert, but he should know enough about each type to enable him to assist in planning certain work for initial economy and for savings in operation.

RECORDS OF CONSTRUCTION COSTS

Familiarity with construction costs and with the preparation of trustworthy estimates is vital for the construction engineer. This will require some elementary knowledge of cost-keeping methods and graph making.

Construction costs should be treated with the importance they deserve. Foremen should be shown the field costs of their work regularly. They should not be ignored for they know the capacity of machines, how much of certain kinds of work certain numbers of men can do, how much and what kind of explosives are required for varying rock excavation, and a multitude of other matters. This knowledge, when combined with the technical background of the engineer, can take much of the uncertainty out of construction costs. This co-operation is essential.

Too few young engineers are earnest enough in learning about costs. If they have paid too little attention to them, they may be in for some embarrassing situations when added responsibilities come their way. Final costs that greatly exceed initial estimates reflect no credit on an engineer, and add nothing to his reputation. An engineer with too little knowledge of costs, one who constantly underestimates, is a genuine menace to the construction industry.

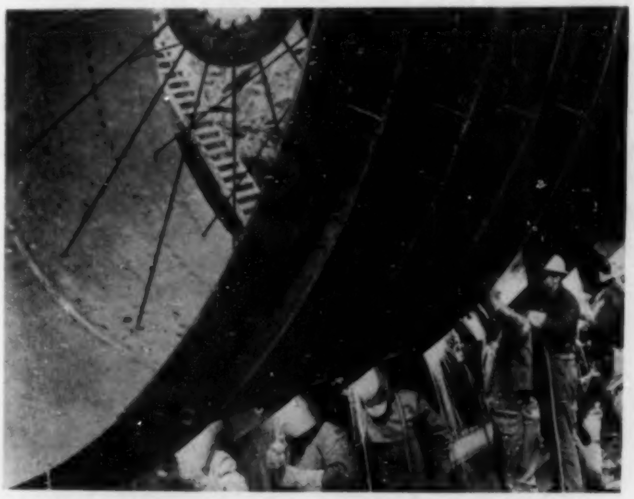
PROGRESS SCHEDULES

Close in importance to accurate cost keeping comes the preparation of progress schedules. What certain operations will cost almost always depends on how much time will be required to complete them. The following incident is typical of the impractical attitude that ignores the value of progress schedules:

"How are you getting along?" a carefree contractor on a hurry-up job was asked.

"I'm whittling away at it," he replied. "So much done today, so much tomorrow. Just give me time."

But the time was not given him. Progress that satisfied him did not satisfy the owner. After several sharp warnings, none of which had any effect, the owner took over the job and made other arrangements for its completion.



The Lincoln Electric Co.

Field Inspection Requires Understanding of Practical Operation Limitations

Fabricating a Penstock Section

In countless similar situations, the graduate engineer can be helpful to others—and to himself—if he has learned something about progress schedules. It is hard to overestimate their value, and almost impossible to carry a job through at maximum efficiency without them. When it can be seen, day by day, whether a job is being done in accordance with a predetermined rate of progress and scale of costs, or whether it is falling behind, delay and financial disaster can almost always be averted.

Blaw Knox Co.

A Careful Progress Schedule Keeps Men and Equipment Busy on an Airport Runway

Getting along well with others is of greater importance than many think. This is particularly true with respect to engineers. Some, possessed of unusual native ability or great good luck, may achieve much material success in life while completely disregarding others, but they are relatively few. And most of them are not to be envied; they will not have many real friends, and many of the worthwhile things of life will elude them. Someone is always out "gunning" for them. Unless a man gets along well with others, his handicap is tremendous.

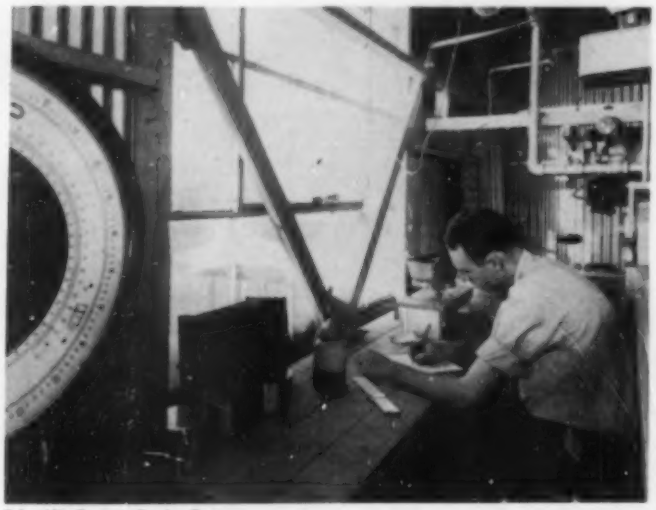
Recently an employer admitted that a certain young graduate was a cracking good engineer. "But," he added, "he antagonized everybody and was a bad influence in my organization. He was always right, the other fellow always wrong. He seemed to take delight in showing up his non-college construction associates, competent practical men. He just didn't fit and won't until he gets wise to himself." This young man was set adrift. He lost a good opportunity with an outstanding concern.

MUTUAL REGARD ENRICHES ASSOCIATIONS

So I would advise the young engineer: Don't be sophisticated with the practical construction man; you need him as much as he needs you. Don't highhat him because he can't use a transit or a level, or make a drawing. His knowledge is as valuable as yours. He knows engineering, too, a kind you must learn. Don't ridicule him because he isn't a genius at mathematics or design. You might ridicule someone who actually is more intelligent than you, or who might later employ you. Don't forget that your skill is useless until the experienced constructor transforms it into physical being. Don't forget that the practical constructor spends more years and effort in learning his work than you have spent in learning mathematics and design. It will take you a long time to learn what he knows. Cultivate him and shorten this time as much as possible.

Remember these things; they will enable you to evaluate yourself properly. They will make you a cooperator and a builder of good will, and as a result others will want to teach, advise, and help you. Otherwise you will find barrier after barrier across your path. Don't let egotism take root in you; it will shut you out from some of the most worthwhile things of life.

Do not minimize the value of instruction in public speaking; it will be invaluable. Few inarticulate engineers achieve lasting success and prestige. Just as soon as the young engineer has sufficient experience and prac-



Scientific Concrete Service Corp.

ROUTINE OPERATIONS SHOULD NOT KILL THE YOUNG ENGINEER'S INTEREST IN HIS WORK

Fresh Concrete Being Dried on a Hot Plate for Field Control

tical knowledge, he should write about his work and try to get his efforts published. This is good training towards preparing acceptable reports; it widens acquaintance and increases opportunities. It also contributes to accurate and thorough thinking. Never forget that to be merely a good technician is not to be an all-around, good engineer.

IMPORTANCE OF PROGRESSIVE VIEWPOINT

The times are changing rapidly. Present-day mortality in time-honored customs and beliefs is awesome. The success of the engineer of the future will depend as never before upon his broad cultural background, his acceptance of the idea of a better order, and his work in helping to bring it about. He must accept, too, the social trend, and learn to believe in and take part in improved human relations. Unless he does, his future may not be promising. A college course simply produces graduates who later may develop into mature engineers. While the embryo engineer is still in college, it is important for him to recognize and keep in mind the value of an early acquaintance with practicality. If he understands the type of engineer best adapted to the new society, he can work to make himself fit in every possible way.

So often, engineers later regret bitterly that they did not complete their college courses. No sacrifice should be considered too great to make such completion possible, if it is the student's fixed purpose to follow engineering. The training is vital; engineers must have it or its equivalent. The equivalent takes a distressingly long time to acquire, and necessitates many sacrifices. Here is what that great engineer, John F. Stevens, had to say about this:

"There can be no question as to the great value of a technical training as a prelude to a successful engineering career.

"Often it is said that such and such a person has done well and made a name for himself without the benefit of a technical education. In 100% of the cases cited the statement is not true. Every real engineer must possess in a greater or lesser degree technical training or knowledge. And few of those who comment so glibly upon the lack of necessity for such training at school realize the hard and unremitting study of books and publications and the close observation which the self-educated engineer must pursue during many years, to the neglect of his social and general obligations to the world in which his lot is cast.

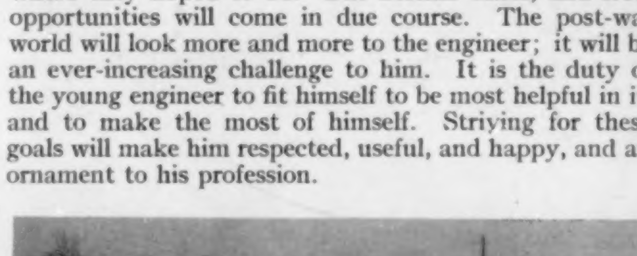
"I speak feelingly in regard to this matter. Sixty years ago the young man who was then privileged to enjoy the benefits of a technical education was the great exception, and at that earlier period engineering was hardly recognized as a profession; at least it had not to any great extent acquired the high standing that it now enjoys."

Again I would remind the embryo engineer: Study ceaselessly how to get along acceptably with owners, your fellow engineers, all others with whom you come in contact in following your profession. Socrates said that man's greatest work is to help his fellows to get along better with one another. Don't worry about missing credit for what you do. If you are competent, get along acceptably, and become known as a teamworker and a man of integrity, nothing can withhold from you all the rewards that are justly yours.

Don't become impatient at what seems delay in the fruition of your plans. Remember that to become an outstanding engineer requires time and experience. Persevere in the right direction and with the right spirit. Reward will surely come.

Last, but certainly not least, learn something about prospective employers. Is their record good for helping young men? If it is not, shun them. Do not remain where loyalty, extra effort, and proved ability are not recognized and properly rewarded. Growth is not possible in a hopeless environment. If necessary, change your early position again and again until you find really promising ground. But be sure that you are right before you make a change. Investigate, inquire. Many are lured by concerns that promise much and give little, or that fade out of the picture through lack of stability. Landing in a hopeless situation and remaining too long has blighted the careers of many promising young engineers.

Today nothing is normal. Among countless others, many student engineers find themselves far afield from where they hoped to be. But normal times, and freer opportunities will come in due course. The post-war world will look more and more to the engineer; it will be an ever-increasing challenge to him. It is the duty of the young engineer to fit himself to be most helpful in it, and to make the most of himself. Striving for these goals will make him respected, useful, and happy, and an ornament to his profession.



Allis-Chalmers

LARGE NUMBERS OF MEN MUST BE HANDLED SUCCESSFULLY ON MODERN PROJECTS

Grading Work for an Army Barracks

Davison Limited Highway—Wayne County, Mich.

Part II. Factors Affecting Design and Construction

By Harry A. Shuptrine *and* Julian C. Mead, Members Am. Soc. C.E.

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As explained by Messrs. Shuptrine and Mead in Part I, in the December issue, the Davison Highway through Highland Park, Mich., was constructed to relieve serious traffic congestion. Since it was to be a limited-access route, studies were made of the relative merits of elevating or depressing the roadway. The latter solution was chosen, a fortunate one in view of the need that soon developed for conserving critical materials.

A thorough study of the traffic requirements of the area resulted in the acquisition of a 205-ft right of way for the Davison Limited Highway through Highland Park, Mich. This provided enough width to permit the use of side slopes along a depressed highway of six traffic lanes. The cost would be much less than that of a viaduct of the same capacity.

The control points on the grade of the new route occurred at the cross streets. They were determined after preliminary profiles and sections had been prepared for each street, based on the location of trunk and storm sewers, headroom under bridges, grade of cross streets, architectural treatment of bridges, and maintenance of traffic and utility services.

The paving width on previously widened sections of Davison Avenue is 80 ft, or the equivalent of a traffic artery 66 ft wide plus two parking strips. It was therefore logical to design the depressed section with two 33-ft pavements for rapid transit (see Fig. 1). These, separated by a 6-ft median strip, extend throughout the length of the job (about 7,000 ft) with one exception. Approaching the Woodward Avenue Bridge, the pavement is widened for a distance of some 450 ft in the northeast and southwest quadrants, to provide space for bus stops.

Local traffic is accommodated by two drives 22 ft wide, at grade, one on each side of the depressed highway. The 9-ft strips between the curbs of the local drives and the property line provide room for street lighting and hydrants as well as for 6-ft sidewalks. One-way traffic only is permitted on the local drives and there are no interchanges between local and through roadways, except at the ends of the project.

On the south side of the west entrance, the presence of a large brick school building forced a modification of the typical cross section. The full 205-ft width of the right of way could not be obtained except by wrecking 25 ft of the building and seriously affecting the value of the remaining portion. To avoid this, the southerly local roadway in this block was omitted. This was not considered serious, since the school occupies a full square and is served by three other streets. A sidewalk of 10-ft minimum width was provided along the north side of the school. To support the walk and the school foundiation a retaining wall was built alon the depressed roadway. The school foundation at this point is about $4^1/_2$ ft below the natural ground level, and 14 ft above the bottom of the retaining wall footing.

This arrangement permitted the alinement of Davison Avenue west of Lincoln Avenue to be produced, without reversal, to a point opposite the school, where a gradual reverse curve was introduced to meet the alinement between Hamilton and Woodward avenues. East-bound vehicular traffic desiring to reach the local drives can do so by means of a paved ramp 12 ft wide diverging from the through traffic lane just east of Hamilton Avenue. The east entrance to the project is flanked by paved roadways 40 ft wide for local two-way traffic, connecting with Oakland Avenue.

At all north and south streets the bridges are wide enough to accommodate the connecting drives which join the local drives on each side of the highway. These drives are located outside the sidewalks on the bridges to avoid interference of U-turn traffic with through north-and-south traffic. To provide easy turning movements, the bridge fascias, wing walls, and curbs on the side-drive approaches follow compound curves with a minimum radius of 32 ft and an easement radius of 400 ft at each end.

Replacing One 54-In. Sewer by Three 33-In. Ones

Junction Chamber (Foreground) Permits Uninterrupted Operation

Design of Bridges

All bridges carrying the north-and-south streets over the depressed portion of the highway are of reinforced concrete, hinged, rigid-frame construction. The highway bridges are designed for H20-S16 loading and the street railway bridges for 40-ton freight-car loading, according to the specifications of the American Association of State Highway Officials. Maximum stresses were computed for combinations of dead load, live load, impact, earth pressure, and rib shortening, plus and minus stresses due to a temperature change of 50 F. Sections were computed using Joint Committee allowable stresses for 3,000-lb concrete.

Footings of all bridges are designed to produce an average

dead-load soil pressure of 3,700 lb per sq ft and a maximum toe pressure of 4,700 lb per sq ft for all loads except impact. Samples taken at the elevation of the bottom of the footings from borings at the site of the work were of a hard, moist blue clay, tests of which developed a much higher bearing capacity than the loads would require. In the case of the single-span bridges, the direction of the resultant loads on the bottom of the footing was materially inclined from the vertical. Therefore the footing was sloped at the rate of 1 vertical to 6 horizontal to bring the bearing surface approximately perpendicular to the average resultant.

ERECTION OF DECK FORMS FOR HAMILTON AVENUE BRIDGE
Temporary Trestle Carries Street Railway

The bridges at Hamilton and Oakland avenues carry the double-track structure of the Detroit Street Railway in addition to the roadways for through and local interchange traffic, and provide two 37-ft 2-in. clear spans with an open-type center pier 3 ft thick. A slight skew at the Hamilton Bridge makes the span lengths somewhat greater than those at the Oakland Bridge, but the same rib thickness and reinforcing-steel design were used for both structures.

On each of these three bridges the street railway section, 17 ft wide, is the central unit, and has thicker slabs than the adjacent highway sections. The depth from the street surface to the underclearance is further increased to accommodate the trench in the deck to receive the track structure.

RETAINING WALLS AND STAIRS

At certain locations the right of way is not wide enough to accommodate the necessary improvements without substituting retaining walls for side slopes. The necessity for a wall at the school just west of Hamilton Avenue has already been discussed. In addition, retaining walls were required for the ramp between Hamilton and Third, and for the bus-loading stations at Woodward. These walls are of the cantilever type with footing widths about half the wall height. Toe pressures on the soil do not exceed 3,000 lb per sq ft, and the horizontal component of the reaction at the bottom of the footing does not exceed one-third the vertical component. The faces of all wall and abutment footings were required to be poured against the undisturbed clay.

Reinforcing bars are discontinuous at wall construction joints above the footings, and the back face of such joints is calked and covered with two-ply membrane waterproofing. Backs of walls are dampproofed and backfilled with sand and gravel over the open-joint drains which are placed on the footing. Occasional manholes are provided to permit rodding of the drains should they become plugged.

Stairways with landings at the half-way points were built at the four corners of the Woodward Avenue Bridge to accommodate pedestrians using the bus stops. The space under two of these stairways is made accessible for storage of road maintenance tools through the installation of a 5 by 7-ft doorway fitted with double hollow metal doors.

MISCELLANEOUS STRUCTURE DETAILS

The use of a wearing surface on the bridges introduced the necessity of draining off possible accumulations of water between this surface and the bridge slab. Details of the bridge deck include dowels to reinforce the joints, a calked V-groove at the top of the joint, and sand-filled grooves to lead the water to $^3/_4$-in. pipe weepers. The use of a bituminous seal coat on the concrete slab, other than the primer used for sheet-asphalt paving, was avoided because of its possible softening effect on the asphalt wearing surface. For the same reason a rubber compound was used for sealing the oakum-calked joints. Where concrete curbs and walks rested on the slab, a metallic waterproofing was used.

The rail braces used to permit removal of abutment forms and blocking prior to the time the deck was poured are shown in Fig. 2. When the deck concrete reached sufficient strength (500 to 1,000 lb per sq in.) as determined by test cylinders, the rail braces were severed by burning, thus permitting the required hinge action where the rib rests on, and is doweled to, the footings. The number of braces is dependent on the number of shaft sections, and the latter is dictated by construction requirements.

Bridge handrail sections, approximately 8 ft long, are made up of square pickets welded to channels, which in turn are welded to tube-steel runs. The tubes project into posts and are held by dowels extending through round holes in the posts and slotted holes in the tubes. Dowels are made extra long and pointed for easy erection. After erection the dowels are burned off flush with the face of the posts, welded, and ground to a smooth surface. The channels on the rail section are cut to provide a $^1/_8$-in. clearance at the posts and thus limit the possible movement in each 8-ft section to approximately $^1/_4$ in. Posts are made up of two 7-in. ship channels with base and cap plates, welded throughout.

At all north-and-south streets except John R, existing or proposed trunk sewers required special consideration.

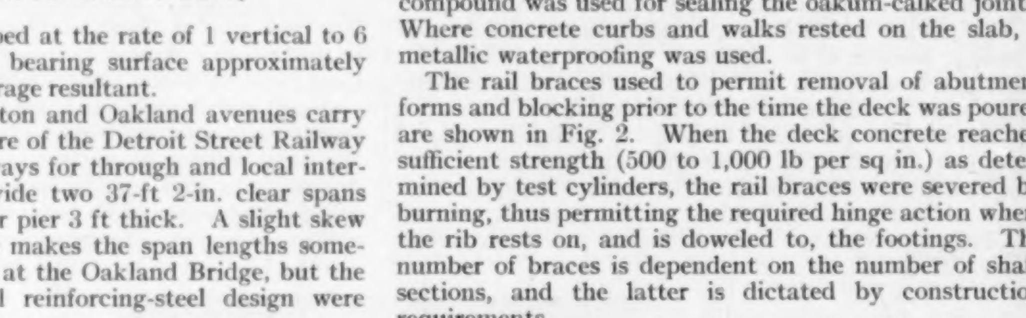


FIG. 1. TYPICAL CROSS SECTION OF DAVISON LIMITED HIGHWAY

With the cooperation of the city of Highland Park, new arrangements were devised for reconstructing existing trunk sewers on three streets, since in each case the top of the old sewer projected above the proposed subgrade of the depressed highway. At Hamilton Avenue the existing $4^1/_2$-ft circular sewer was replaced by three 33-in. reinforced concrete pipes. At Woodward, the existing 3 by $4^1/_2$-ft egg-shaped sewer was replaced by three 27-in. reinforced concrete pipes. At Oakland, since the old 4-ft sewer crossed Davison Avenue and then turned east along it, it was decided to construct a new sewer on the north side of Davison, crossing it far enough east to get under the rising grade of the east entrance to the project, thereby avoiding the complications attending the reconstruction of the sewer under the bridge.

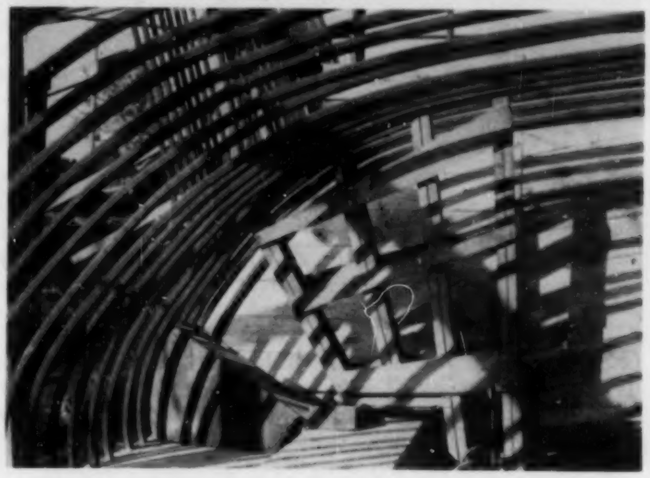
The use of multiple small sewer pipes permitted the new inverts to conform with the old without requiring too high a grade for the depressed highway. This also afforded continuity of flow, since when two new lines had been constructed alongside the old sewer, the flow could be diverted into them. Junction chambers were constructed back of each abutment at Hamilton and Woodward to care for the transition from one to three sewers. In all these crossings the sewers were on the center line of, and directly under, the bridge.

At Second Avenue the existing 4-ft circular sewer was low enough so that it was possible, between footings, to reinforce the top with a concrete encasement which just cleared the sand subbase for the paving. At footings the concrete was carried down to the elevation of the bottom of the sewer, encasing as much as possible of the lower half without disturbing the soil directly under the middle quarter. Over the upper half, $1^1/_2$-in. bituminous felt was placed to absorb settlements in the abutments without unduly loading the sewer. At Third Avenue a 5 by 7-ft reinforced concrete box sewer, and at Brush Street a 5-ft concrete pipe sewer, were constructed under the bridge structures as the first units of future sewers to be built by the city.

As a precaution against leakage through the joints and into the pumped drainage system of the depressed highway, all pipe trunk sewers were encased in concrete. The construction and reconstruction of trunk sewers, junction chambers, and short sections of storm sewers crossing directly under the trunk sewers were included in the bridge contracts. Thus the programing of all work in the area affecting the bridge construction was the responsibility of one contractor.

STORM SEWERS AND PUMP HOUSES

The combined sewer system of Highland Park is the natural outlet for the drainage of the depressed highway, but the trunk sewers crossing the project were not sufficiently deep to take such drainage safely without pumping. It was therefore arranged that the drainage would flow to four pump houses located adjacent to four of the crossings—Hamilton, Second, Woodward, and Oakland—each serving not over 1,800 lin ft of highway. Fewer pump houses could have been used, but that would have added to the depth and size of the sewer pipe as well as increased the pumping heads and overloaded the trunk sewers. Moreover, by interconnecting the Hamilton and Second Avenue systems, and the Woodward and Oakland Avenue systems, standby service for each pumping installation was assured. This flexibility provides against occasional interruptions to pumping operations due to local storms and electric service failures.



REINFORCING FOR THE HAUNCH OF A SINGLE-SPAN BRIDGE
Field Bending Over Template Shown Simplified Concreting Procedure

Each pump house has sufficient capacity to handle $1^1/_2$ times the computed runoff from a storm of $2^1/_2$ in. per hour, when pumping against a 25-ft dynamic head. Under such conditions one pump would not need to operate and would only cut in if one of the other pumps failed to function, a reasonable precaution for automatic stations that are visited by a maintenance man only once a week.

Each pump house is equipped with three independent pumping units except that at Hamilton Avenue, which has two. Each unit consists of a centrifugal non-clogging, sewage-type pump with bronze open impeller and bronze fittings, capable of pumping 2,400 gal per min at 860 rpm against a head of 25 ft, direct-connected to a 25-hp, 900-rpm, 220-v, 3-phase, 60-cycle, vertical induction motor with moisture-resistant insulation. Shafts are fully enclosed in a pipe casing packed with grease to lubricate bearings and protect shaft and bearings from corrosion. Each section of casing is provided with a grease-gun connection for renewing the packing. Control equipment sufficient for independent operation of each pumping unit is installed on a panel board in each pump house. No provision is made for heating the pump houses since no difficulty from freezing has been encountered in previous installations where the major part of the pump house and well were underground.

Lighting of the depressed highway is accomplished by 1,500-cp lights, bracketed from metal posts placed 3 ft 8 in. back of the outer curbs at 100-ft staggered spacing. Along the local drives, 1,000-cp lights stand

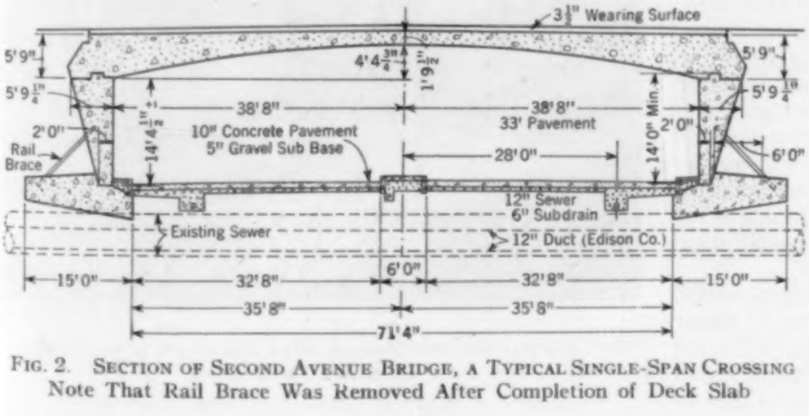


FIG. 2. SECTION OF SECOND AVENUE BRIDGE, A TYPICAL SINGLE-SPAN CROSSING
Note That Rail Brace Was Removed After Completion of Deck Slab

POURING ABUTMENT FOR SECOND HALF OF WOODWARD AVENUE BRIDGE

Traffic Was Maintained Throughout Construction

between the curb and the property line on 200-ft spacing. There are additional lights on the north and south streets where they cross the highway. All light centers are set approximately 25 ft above the pavement.

In addition to the street lighting, 150-w pit lights were installed in the faces of the Hamilton, Woodward, and Oakland bridges 8 ft above the curb, spaced about 22 ft apart. The Hamilton and Oakland bridges are lighted because of their proximity to the entrances of the project, and the Woodward Bridge because of its low-level walks serving bus stops and stairways.

RELOCATION OF UTILITIES

Each north-and-south street crossing the project carries primary mains of the Highland Park water system, varying in size from 12 to 24 in. All these had to be relocated outside the bridge structures and at a grade such that the top of the main would fall at least 5 ft below the top of the paving of the depressed highway. At the Oakland Avenue entrance, two 24-in. pipes which serve as the main supply lines from the water filtration plant, a few blocks east of Oakland, were also seriously affected by the change in street grade. One of these was relocated under the north entrance drive, while the other was lowered for 600 ft of its length, since the highway at its location was not greatly depressed.

All the new water mains were laid before excavating for the depressed highway so that shutoffs could be limited to the time required for connecting into the old lines and flushing and chlorinating the new. This procedure involved construction of mains in trenches up to 28 ft deep.

At the Hamilton Avenue end of the project, 6 and 8-in. laterals and their service connections had to be reconstructed because the old main fell within the limits of the cut. But elsewhere mains in the old Davison right of way were undisturbed except for connections at intersecting streets. It was necessary to discontinue all service connections leading south from the Davison laterals since these would be intercepted by the road cut. This was done by digging separate holes at the main for each house connection and shutting off the corporation cock.

Responsibility for the reconstruction of publicly owned utilities was assumed by the Board and involved water mains, sewers, and police and fire signal lines belonging to the city of Highland Park as well as fire department signal lines belonging to the city of Detroit. Lines of privately owned utilities were rebuilt by the owners at their own expense and involved underground construction of the Detroit Edison Company, the Michigan Bell Telephone Company, and the Michigan Consolidated Gas Company, all of whom worked very efficiently in cooperation with the Board.

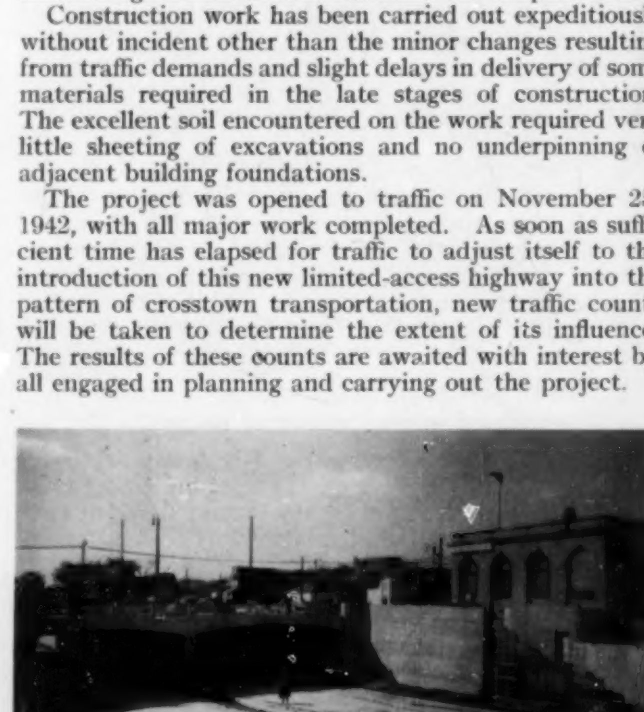
At the Second, Woodward, and Oakland Avenue crossings, the Detroit Edison Company had twelve important duct lines which had to be maintained in service. The company therefore decided to construct a new conduit in tunnel below the future bridge footings with splicing chambers well back of the bridge abutments to connect the new and the old cables. This work was completed prior to the bridge construction at these crossings. At Third, Brush, and John R streets, twelve new duct lines were laid for future use in open trench below the bridge footings, this work being correlated with the bridge construction.

The telephone company, whose trunk lines were involved at the Hamilton, Second, and John R crossings, preferred to avoid deep construction. Permanent locations were therefore assigned to its conduits and cable in the 10-ft sidewalk slabs on the bridge structures. Program schedules, which differed for each crossing, were prepared so that service would not be interrupted. In general, the procedure involved constructing large underground splicing chambers, splicing in an extra length of cable, and supporting it temporarily above or along side of the bridge structure until it could be placed in its final location.

Gas mains, which were comparatively small, were also carried across the bridges in the sidewalk slabs. Police and fire signal lines were handled like the telephone lines.

Construction work has been carried out expeditiously without incident other than the minor changes resulting from traffic demands and slight delays in delivery of some materials required in the late stages of construction. The excellent soil encountered on the work required very little sheeting of excavations and no underpinning of adjacent building foundations.

The project was opened to traffic on November 25, 1942, with all major work completed. As soon as sufficient time has elapsed for traffic to adjust itself to the introduction of this new limited-access highway into the pattern of crosstown transportation, new traffic counts will be taken to determine the extent of its influence. The results of these counts are awaited with interest by all engaged in planning and carrying out the project.



WOODWARD AVENUE BRIDGE WITH STAIRWAY (FAR RIGHT) FOR BUS PASSENGERS

Door from Stairway Leads Into Pumping Chamber

Heavy Foundations Drilled Into Rock

Deep Caissons with H-Beam Cores for Extension to a Public Service Building

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TO carry heavy building loads to rock 100 ft below the surface, adjacent to a river, is a nice problem in engineering construction. In the method here described, 30-in. pipes were sunk and driven into the drilled rock. Then sockets were extended downward as much as 8 ft, and in the dry continuous H-beam cores were concreted in. Accurately located and plumbed, these caissons support loads up to 1,356 tons.

FOUNDATION conditions at the site of a large public service plant in an Eastern city have formed the subject of valuable engineering studies, from the construction of the original station in 1920 through each different extension up to the one just being completed. A description of the development of the foundation design, section by section, makes an interesting engineering story.

The site consists of a large plot affording ample room for the station and future extensions, coal storage and outdoor switchyard, on the bank of an important river where deep water is only a few feet from shore. This waterway, open to navigation nine months of the year, provides good transportation facilities for fuel, and a reliable source of cooling water.

EARLIER CONSTRUCTION AT THE SITE

A longitudinal section of the soil strata under the site is shown in Fig. 1. The boiler room is on the side nearest the river and its floor is at El. +31.0. The condenser-room floor is at El. +12.0, with longitudinal intake and discharge tunnels extending about 26 ft below this level.

The sizes of turbine generators and heights of boilers installed in 1920, in conjunction with the service areas required in an initial installation, and coupled with the considerable weight of earth removed for the condenser room, resulted in a reasonable intensity of loading on the soil. Hydrostatic uplift from an assumed flood level of +30.0 was a governing requirement on portions of the turbine-room foundations, and made anchorage of some nature necessary. Concrete piles were driven to within a few feet of the under side of the sand stratum, except that the piles under the tunnels, which themselves extended nearly through the sand stratum, were driven to approximately El. −50.0. In addition, a certain number of wood piles were driven into the sand stratum under the turbine room to compact the soil.

Two turbines were installed, with space left for a third. Owing to lack of weight in this area, it was necessary to rely upon friction on the piles to withstand uplift from flood water.

In 1927 it was decided to install a mercury-vapor boiler and turbine. This presented a very different set of conditions, since the boiler occupied a fairly small floor area, but was quite high and heavy. In addition, the mercury turbine was mounted on top of the boiler. This resulted in a high intensity of loading, which fact, coupled with the need of holding the turbine level and of preventing any unequal settlements, even small, such as might strain the boiler sufficiently to cause leakages of mercury vapor, resulted in the decision to support this extension on bedrock, 120 ft below the ground surface and 85 ft below low water. At that time the most feasible method of accomplishing this purpose appeared to be the installation of pneumatic caissons. Accordingly this was done, although it was realized that it was, of course, a relatively slow and expensive type of foundation.

In 1929 the third unit was installed in the space provided in the original turbine room. The 1930 construction consisted of an extension to the boiler room only. Advances in the art of design of combustion equipment, since the construction of the original station, led to the selection of a fairly high boiler of large steam capacity, with the fan room located above the boiler.

Several factors were considered in the selection of the type of foundations for this extension. As the original station rested on a deep bed of soft clay, there had naturally been some settlement, although of insufficient amount to have any visible effect on the structures or to affect operation. It was expected that the extension, if its weight were allowed to be carried above the clay,

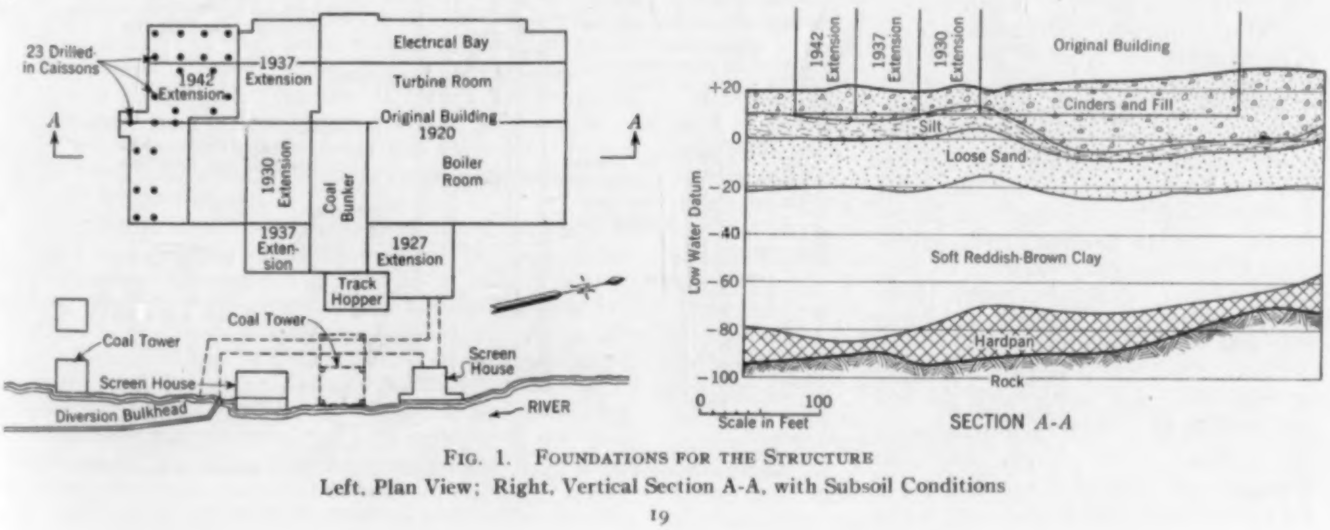


FIG. 1. FOUNDATIONS FOR THE STRUCTURE
Left, Plan View; Right, Vertical Section A-A, with Subsoil Conditions

would likewise settle somewhat after construction, causing strains and misalinement at the connections between the sections, and adding to the settlement of the original station.

Looking ahead to the future construction of a section of turbine room opposite this boiler-room extension, it was seen that difficulty would be experienced in making the condenser-room floor and walls tight at the connections under a head of flood water when building on a foundation that would settle. It was also considered undesirable to conduct pile-driving operations close to the end of the turbine room. The type and arrangement of combustion equipment also made it desirable to have an unyielding foundation. In view of the previous successful installation of pneumatic caissons in 1927, this type of foundation was selected for the 1930 extension.

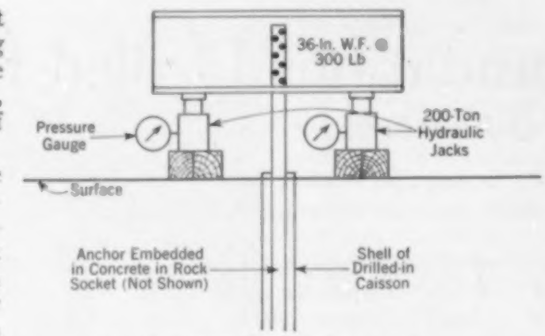


FIG. 2. ROCK BOND TEST FOR UPLIFT

Stress Between Concrete and Rock Walls of Socket Reached 386 Lb per Sq In. Without Slip at Limit of Apparatus

The 1937 extension comprised additions to both the boiler and turbine rooms, and for reasons similar to those governing in 1930, it was decided to carry the loads to rock. Because of the new high-water record made in 1936, this extension was designed to resist flood water to El. 40.0. Meanwhile, because of labor union and Department of Labor requirements, the cost of labor under air had greatly increased. The power company, through its agents, Stone and Webster Engineering Corporation, investigated the feasibility of other types of rock-bearing foundations. The result was the adoption of a mechanical process of excavating a hole to rock without the use of sheet piling. Caving was prevented by the introduction of a mud slurry into the hole, and when the rock was reached a steel shell was set, the slurry pumped out, and the shell filled with concrete. These shells ranged from 5 to $6^1/_2$ ft in diameter. Despite some mechanical difficulties, the installation was successfully completed. The higher flood-level assumptions added considerably to the amount of hydrostatic uplift which the station was called upon to resist, and account was taken of probable skin-friction values on the caissons for this purpose, the foundation mats being anchored down to the caissons and tested (Fig. 2).

Subsequent to the construction of the 1937 extension, the U.S. Engineers designed and installed an extensive levee system along the river to protect the city from the floods which intermittently cause a great deal of damage. This levee extends along the site of the power plant, separating the station from the river and reducing the uplift to which it will be subjected from future floods. For the present (1942) extension, it was naturally decided to continue carrying loads to bedrock. However, another new method of doing this was now available, namely, the drilled-in caisson. A large installation of this type was under way for the foundations of a 16-story warehouse in an eastern Navy Yard, and the engineers of Stone and Webster Engineering Corporation were invited to inspect the work.

At the Navy Yard nearly two hundred caissons were being carried to a depth of 130 ft through clay, sand, and boulders, and socketed into the rock as much as 10 ft. The engineers actually went down into the rock sockets, and were greatly impressed with the advantages of this method, which they immediately adopted for their new foundation. The approved design (Fig. 1) called for 21 caissons 100 ft long supporting column loads as high as 1,356 tons.

Essentially, the drilled-in caisson is a composite, restrained fixed-ended column terminating in a rock socket in which the load is delivered by direct bearing and bond to the bedrock. This bond also provides large uplift resistance where needed. Because of these features it is possible to support heavy loads with a minimum column cross section. The caisson consists principally of the following:

1. A heavy, large-diameter steel cylinder with a strongly reinforced cutting edge or shoe which is seated in bedrock.

2. A socket of approximately the same diameter as the pipe drilled into the rock beneath the pipe for a number of feet by churn drilling methods.

3. A steel H-beam core extending from the bottom of the socket to above the cutoff elevation of the pipe. (Because of the steel shortage, it was necessary to reinforce the H-beams with rails and plates to provide the necessary area.) The load in the steel core is delivered by bond to the surrounding concrete and, in turn, is delivered progressively by bond from the concrete to the walls of the rock socket.

4. The filling of the socket and pipe to the cutoff point with high-strength concrete.

In this case the pipe was 30-in. in outside diameter, spiral welded, with a $^1/_2$-in. wall thickness. As the distance from the ground surface to the rock was from 100 to 116 ft, the pipe was ordered in three lengths—a bottom piece 70 ft long, and two top pieces 35 ft and 50 ft long. The 70-ft bottom piece, as shown in Fig. 3, was

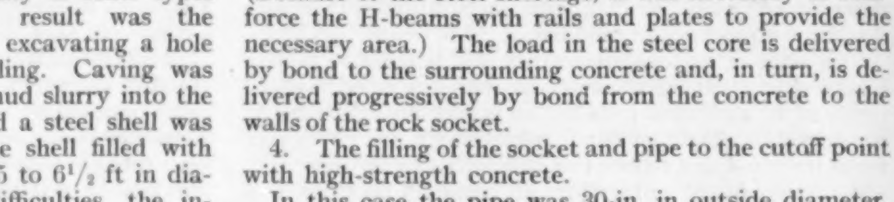


FIG. 3. DETAILS OF CAISSONS AND CORES

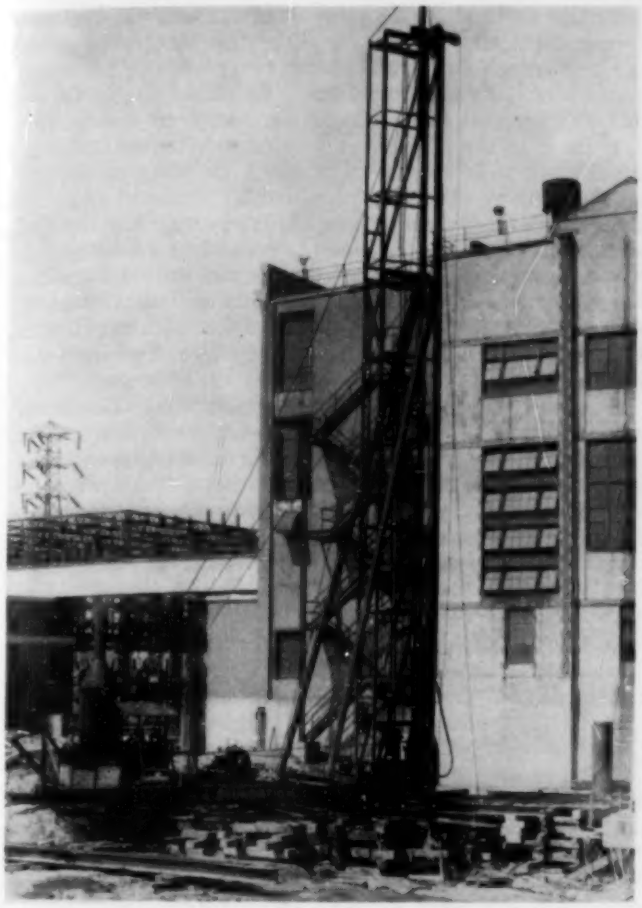


Fig. 4. Steel Skid Pile-Driver, with 90-Ft Leads
Driven Caisson Projecting at Right

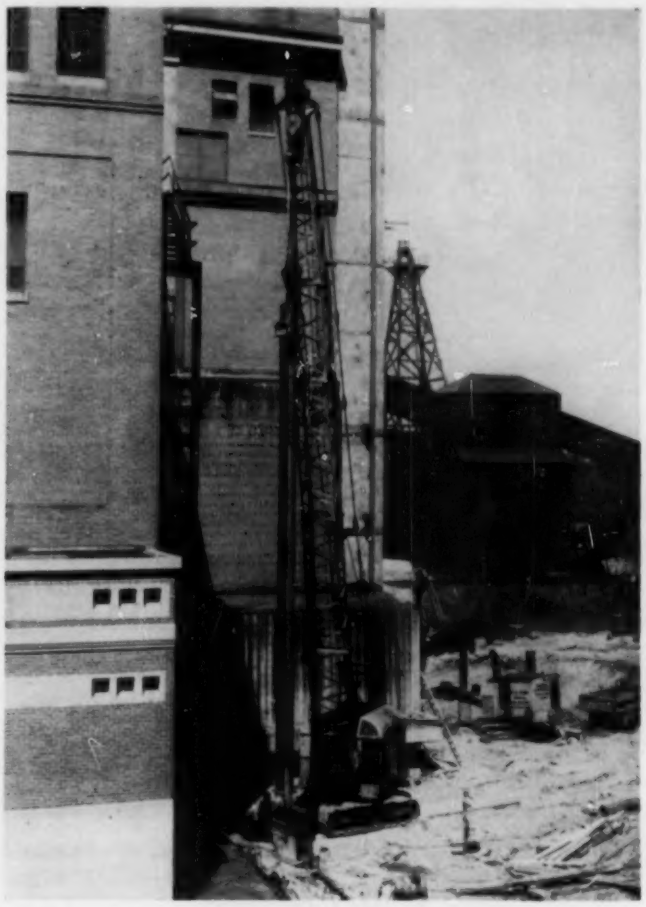


Fig. 5. Crane Lowering H-Beam Core Into Caisson
At Bottom, Welders Splice Two Sections Together

equipped with a $1^1/_2$ by 12-in. driving shoe of tough tool steel, which was attached to the pipe by heavy plug and fillet welds. Similarly fitted to the top of the 70-ft length was a $^1/_2$ by 12-in. outside collar, which served as the splice connecting the top and bottom pieces. The pile driving plant consisted of a steel skid driver (Fig. 4) with 90-ft leads and a single-acting steam hammer with 7,500-lb ram and 39-in. stroke) equipped with a special driving head for the 30-in. pipe.

Great pains were taken to put the cylinders down as nearly plumb and as accurately located as possible. Plumbness was secured by carefully checking the pipe at the start and at all times during the driving by means of two transits with their lines of sight at 90°. For maintaining proper location, a heavy template made of 12 by 12-in. timbers bolted together to form a hollow square was buried a foot or two in the ground. The weight of the forward part of the pile driver was then made to rest on the template, which was thus securely held while the pile was driven through it.

The extreme care used and the type of soil encountered resulted in unusually close tolerances. No caisson was more than 0.94% (lateral departure to height) out of plumb, while the greatest departure from location was $2^7/_8$ in. and the average was less than $1^1/_2$ in. Obviously such accuracy would be impracticable in soils containing boulders or other obstructions.

Ground conditions were very favorable for driving. A medium resistance was encountered in the top 20-ft sand stratum, but after this was penetrated, only about 20 blows per ft were required to drive through the varved clay and silt to the rock. After the 70-ft length was driven, the muck from the inside of the pipe was cleaned out by means of bailer and sand pump, the latter merely a 15-ft length of 12-in. pipe fitted with a flap valve at the bottom and a piston which was jerked upward through the cylinder by the pile line of the hoist. The powerful suction created drew the sand and clay in lumps up into the pipe, which was emptied at the surface. The 30-in. cylinder was kept full of water to prevent blow-ins at the bottom on account of the adverse head of water from the river.

The bottom length of pipe having been mucked out, the top 35-ft or 50-ft length of plain pipe was next inserted into the splice collar at the top, carefully plumbed, welded securely in place, and the entire cylinder driven to rock. The pile-driving rig was then moved to the next location.

At this stage in the operation, the drilling rig went to work. This machine was a churn drill skid-mounted or pneumatic-tired, powered with a 50-hp gasoline engine. Its first operation was to clean out the 35 or 50 ft of muck remaining in the pipe above the rock. Then by means of a 4,000-lb cross-shaped bit, 28 in. over the wings, it churn-drilled a socket into the bedrock. This was done by alternately drilling and bailing out the rock cuttings. After the first foot or so of socket had been drilled and cleaned out, a caterpillar crane handling a steam hammer (5,000-lb ram with 36-in. stroke) then drove the steel cylinder from 6 to 12 in. below the surface of the rock. This redriving of the cylinder was generally effective in sealing off the ground water, which was under a head of from 90 to 100 ft, so that the caisson could be completed in the dry. The socket was then drilled further down, a minimum of 4 ft, and a maximum of 8 ft 6 in.

FIG. 6. SUPPLEMENTARY CAISSONS DRIVEN BY CRANES
Unit at Left Sinks First 35-Ft Length; Nearer Machine Is Bailing Out Caisson Just Driven

When a dry socket had been obtained, it was carefully cleaned out and then inspected by the engineers, who were lowered to the bottom in a cage. Examination of the sockets showed that their walls were very sound and free from any loose spalls of rock. The heavy bit evidently swings in the hole only a negligible amount, and leaves a very clean but somewhat irregular bore. Careful measurements showed that the diameter of the socket was not constant but varied from $29^{1}/_{2}$ to $32^{1}/_{2}$ in.

When the caisson had been bailed out and inspected, and a survey made to determine the plumbness of the cylinder, the next operation was to assemble and lower the heavy steel core and cage into the caisson by means of a 2-cu yd crawler crane equipped with a 100-ft boom (Fig. 5). It usually took about three hours for the riggers and two welders to assemble and lower to the bottom of the socket the three sections of H-beams (the heaviest weighing as much as 22 tons) which made up the completed core. As soon as the core was set, a waiting mixing truck started to pour down into the socket a stiff dry mixture of 1:1 grout, the water cement ratio of which was held to a minimum so that any water which did accumulate at the bottom would not seriously weaken its strength.

Observation by means of suspended lights showed that the grout when dropped from such a height as 100 ft thoroughly absorbed any accumulated water, and previous borings taken in the concrete filling of the 1937 cylinders proved that concrete poured from such heights was very dense and strong. Grout was placed in the socket and carried up several feet into the cylinder, from which point 4,000-lb per sq in. concrete was poured to fill the caisson to cutoff elevation.

By this method the 21 caissons in the original contract were completed. However, after the steel skid leads had been removed from the site, two additional caissons were ordered by the engineers. To avoid the considerable expense and loss of time necessary to return this equipment to the job, it was decided to attempt the additional work with the use of cranes. To make up for the lack of rigidity normally provided by the skid rigs, the shells were set in sheeted pits 12 ft deep. At the top and bottom of these pits, templates consisting of 12 by 12-in. timbers maintained the cylinders in proper location. The driving operation (Fig. 6) was considerably slower, because it was necessary to use a smaller hammer (5,000-lb), and because plumbness had to be checked with greater frequency.

However, the extra cost was far less than that of returning the original equipment to the site. Except for the method of driving, these additional caissons were completed in the same way as the others, and the results were equal in every way. All 23 caissons were exceptionally plumb and true to location. Of course, the ground and rock conditions were particularly favorable.

WHEN TREMIE PROCEDURE IS RECOMMENDED

In this operation, because of the character of the rock, it was always practicable, through redriving, to secure a dry caisson. In the Navy Yard foundation previously referred to, the hardness of the ledge was such that the redriving broke off the rock irregularly. The result was that when water-bearing material overlay the ledge, a watertight seal could not be obtained, though the flow of sand could always be stopped.

For such conditions, the tremie procedure used in the Navy Yard is recommended. The socket should be filled with grout deposited through water by means of a bottom-dumping bucket. The core is placed through the grout on the bottom of the socket, and the grout permitted to set a sufficient time to provide a water seal. The caisson is then pumped out and concreting continued in the dry. Caissons so installed are believed to be in no way inferior to those with cores set in the dry.

Boulders and other heavy obstructions, not present at this site, always increase the difficulty and cost of every type of foundation. To this, of course, drilled-in caissons are no exception. However, it is practicable, in the process, to drill through many obstructions which would prevent the penetration of any type of pile or other types of open caissons. As to pneumatic caissons, their cost, excessive at best, is prohibitive where boulders are present.

From experience on this and other operations, the writer feels that these caissons afford the solution to many otherwise insoluble foundation problems. Only pneumatic caissons are comparable in achievement, and at a greatly increased cost. Furthermore, the drilled-in caisson can be successfully carried to rock at depths far in excess of the legal limit for compressed-air work.

The public service company is already facing new problems as the requirements of the rapidly expanding city grow from day to day. As this is written, they are rushing to completion an emergency coal-handling plant, to provide a 300,000-ton dead storage of fuel. This stock pile will be in place before winter closes the river, and will assure continuous and adequate service to vital war industries, in spite of any shortage of transportation facilities. The features of this design involving the drilled-in caissons are patented. It is probable that it will not be long before another plant extension will be required—but the foundation is one problem that can be solved again in this same way.

Chicago Plans for Emergency Sewer Repair

By Thomas D. Garry *and* A. J. Schafmayer, M. Am. Soc. C.E.

Respectively Superintendent of Sewers and Assistant Chief Engineer of Sewers, Chicago, Ill.

Civilian defense activity in the Chicago Metropolitan Area has an organization and status similar to that of a state, as it includes, in addition to the City of Chicago, over one hundred suburban communities. Under the direction of Mayor Edward J. Kelly, M. Am. Soc. C.E., U.S. Coordinator, and Oscar E. Hewitt, Chief of Public Works, the many branches of the vital work are carried on through those public agencies best suited to the tasks in question. Under the direction of Mr. Garry, the Bureau of Sewers has had special training in emergency repair work under simulated bombing conditions. This paper was originally presented before the Sanitary Engineering Division at the Society's Meeting in Minneapolis, Minn.

A PLAN for restoring sewers to service in case of possible air raids was initiated in January 1942 by the Bureau of Sewers of the City of Chicago, and on February 6, a tentative plan for such repair and maintenance was submitted to the Commissioner of Public Works. It was assumed that the regular forces of the Bureau would form the backbone of any emergency organization to deal with air raid damage. It was also assumed that in extreme cases these regular forces would be expanded with volunteer labor from the OCD lists. In such cases the regular forces would be divided into small gangs to form a nucleus of experienced men in each of the groups.

The general organization of the Bureau of Sewers was given in this report. The seven cleaning and operating districts and the three sewer repair districts were shown on maps accompanying the report. (See Figs. 1 and 2 for outline maps of these divisions.) Normal labor forces were assigned to the seven cleaning districts, and there was a similar assignment of labor and equipment for the three repair districts. For inclusion in the report a tabulation was made of material on hand—machinery and heavy equipment, tools, small equipment, and supplies—together with statistical data for the sewer cleaning districts giving area, population, miles of sewer and number of appurtenances. Estimates were then made of items that might be needed for emergency repairs in addition to those on hand. Later, on receipt of offers from the Sanitary District of Chicago to pool its equipment with the city's, the estimate of additional machinery and heavy equipment needed was very drastically reduced.

These inventories and estimates showed a total value of $384,621.81 in tools, equipment, machinery, trucks, and supplies on hand, and $247,751.78 of additional items needed. Subsequent inventories received from contractors in response to questionnaires resulted in the transfer of sundry items from the estimated purchase list to the estimated rental list, giving a much lower total estimate for purchases of heavy equipment.

The estimates were based on certain assumptions. First, it was considered that in a bombing raid of moderate severity 22 or more sewers might be demolished at different locations. The normal force could give full service to 11 such occurrences, as it had 40 men in each of 11 initial gangs. As soon as possible, say in 6 or 8 hours, when the worst of the damage had been temporarily repaired, 20 men could be sent home from each gang and the other 20 could work 8 hours more. Then at the close of this 8-hour period, the 20 men sent home would return and work 12 hours, supplemented by 20 to 25 OCD volunteers assigned from "previously prepared lists of volunteer employees of sewer contractors or from labor unions whose members are engaged in similar work."

To expand the organization to cover 22 incidents, the force will be divided into 22 gangs or squads of 20 men each, who will work in the sequence just described for

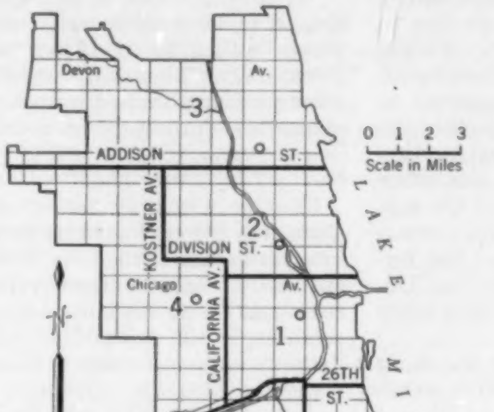


Fig. 1. Seven Sewer Cleaning Districts Plotted on Outline Map

Fig. 2. Division of City Into Three Sewer Repair Divisions

VIEWS OF A DISTRICT YARD OF THE CHICAGO BUREAU OF SEWERS, WITH SUPPLIES READY FOR EMERGENCIES

11 incidents. When working in two 12-hour shifts, there would be only 10 regular experienced men in each shift, supplemented of course by volunteers from the OCD lists. Each nucleus of 10 experienced men would then consist of 1 foreman or assistant foreman, 1 bricklayer, and 8 laborers. A supplementary gang of from 30 to 40 volunteers would work with each such nucleus. For the 44 gangs, this would require from 1,320 to 1,760 volunteers in addition to the regular employees.

EMERGENCY CALLS FOR ENTIRE CREW

It should be noted that all the regular men of the Bureau of Sewers would be required on this emergency work, and that regular work and responses to ordinary complaints would be at a standstill. While this condition might be possible for a short time, it is evident that arrangements would have to be made in a few days to relieve some of the gangs from emergency calls and return them to routine work on complaints and repairs.

The Bureau of Sewers was organized to serve on a 24-hour basis at the time this general plan was developed. This was done by assigning some of the employees to skeleton night shifts in the main office and in each of the seven district offices. Telephone lists of all Bureau employees were prepared for calling from the main office and "fanning out" through the district offices and through key men who would call others in turn. Instructions "For Making Telephone Calls to Employees of the Bureau of Sewers in the City of Chicago for Civilian Defense Emergencies or for Practice Drills" were prepared. Quotations from these instructions follow:

"The regular staff of employees is on duty in the main office of the Bureau of Sewers from 8:30 to 5:00 on weekdays. Shifts of 8 men are on duty each night from 4 p.m. to midnight and from 12 midnight to 8 a.m., and from 8 a.m. to 4 p.m. Sunday.

"In an emergency the OCD call is to come to the Bureau of Sewers on extension telephone No. 629. Assuming the alarm comes during the night, an employee on duty will answer the call, and will summon the other employees to man eight of the telephones in the office and to stand by while he verifies the OCD alarm. After verifying, he will announce the message to the employees standing by at the telephones. One employee will immediately call Thomas D. Garry, Superintendent of Sewers, by telephone, if possible. If not, he will notify Police 1313 to call Car No. 330 on their radio with a message to call his office. Mr. Garry's extension No. 627 will then be left open for incoming calls from him for any instructions he may wish to give. The eight men at office 'phones will then make their alarm calls, as shown on the 'Emergency Call List for the Bureau of Sewers, at 408 City Hall.' One of these lists is placed on the desk under each of the eight 'phones to be used for outgoing calls. A red band has been drawn around the extension telephone number at the top of the column and the names and telephone numbers to be called by the employee manning that particular 'phone. This is for his convenience.

"Two men are on duty on each of the night shifts at each of the seven district yards. The regular yard office staff is on duty during the day. After receiving a call from 408 City Hall, the men in the yard offices will first call the names and telephone numbers indicated on the Squad Call Lists posted near the two telephones in each yard office. After making these calls the men in the yard offices will immediately call the men on the other two shifts of their respective yard offices.

"If during a call it develops that any key man who should make further calls cannot be reached, the employee calling him is instructed then to make the additional calls. These calls are all to be made immediately after receiving his own warning, after which the employee proceeds as promptly as possible to his headquarters....

ASSEMBLY POINTS CONVENIENTLY LOCATED

"For an assembly test or drill, each employee of the Bureau of Sewers has been instructed to report at a definite yard office or the City Hall, as the case may be. Consequently, each employee reports at an assembly point reasonably near his home except in the case of those assembling in the main office, which may be a considerable distance in certain cases. After assembling, all employees stand by at their respective headquarters for specific orders. In the case that for lack of time or any other reason no alarm has been given, employees are instructed to report at their headquarters as soon as possible after any raid or blackout.

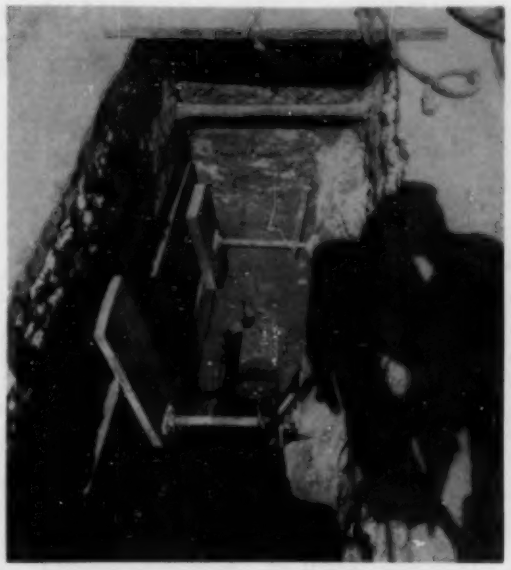
"Each employee has also been instructed that when he is to be absent from his home and cannot be reached on that telephone he is to call his headquarters and leave word where he will be, on what telephone he can be reached, if any, and the probable duration of such absence. The men on duty in the respective offices keep lists of these variations daily, and a slip showing this variation is placed under or near the telephone from which calls are to be made to that particular squad member so that a considerable part of the delays due to such changes may be avoided.

"Day calls will be made from the main office to the district offices. The district offices will then get in touch with employees on the various gangs at work in

their districts either by telephone or messenger, as may be possible."

After the plan had been developed and the call lists prepared, the Bureau held a preliminary communication drill about March 12. In this drill no assembly was attempted. The notices were merely sent out to all employees over the telephone to familiarize the staff with the procedure.

The first assembly drill was held by the Bureau on March 18. All employees were called and given instructions to assemble at their headquarters. After assembling and reporting, the employees returned to their homes, as no simulated incident locations were planned for this test. Table I, the record of this assembly, gives a sample method of evaluating and checking the results.



Estimates for Repairs in Case of Bombing Damage Were Based on Jobs Such as This

On March 23, 1942, the Bureau held its first complete drill, including communication, assembly, and repair at the incident. A section of 6-ft sewer in 73d Street near Euclid Avenue had actually collapsed under the street-car tracks. For the purpose of the drill, it was assumed that this collapse was the result of an enemy air raid. While this damage normally would require only one gang, it was considered for practice purposes that the entire staff of the Bureau of Sewers was needed to make the repairs. Notices were therefore given over the telephones. The squads assembled at their headquarters, whence they were sent to the site of the simulated incident from all the yards in the city.

Upon reaching the spot, barricades, red lights, and flagmen were placed; damage was investigated by a party sent through the sewer to the manhole at the end of the block; and compressors and air-pressure excavating tools were placed in operation. The generator and auxiliary electric light system was set up and operated, and lights strung for illumination. Mortar was mixed and bricklayers laid brick in the sewer for repairs. It should be noted that all the employees of the Bureau had previously volunteered their services for these drills so that there was no cost to the public for salaries or overtime.

The second communication, assembly, and incident drill was held on the afternoon of April 22. The method of communication for a daylight drill or actual raid is different from that at night. The gangs are out on their cleaning, scraping, and repair assignments. It is necessary to call them at telephones nearby or to send messengers. Sometimes gangs may be moving to other tasks. For such cases, the use of the radio to contact trucks with the gangs has been demonstrated as very desirable. It is planned to have the Bureau's trucks equipped for such radio calls, but this has not yet been done. Another complete drill was held on the night of April 28.

It has been customary for the superintendent and most of the office staff to hold a sort of post-mortem immediately after each test to bring out points of success or suggestions for betterment. Occasional meetings of this staff and all foremen and assistant foremen have been held for the same purpose.

Drills Disclose Difficulty in Reaching Men

This preparatory work has shown that it is necessary to keep call lists of the men posted up to date, since changes are occurring constantly. It is necessary to explain clearly to the personnel the procedure they are to follow in such drills or in responding to genuine alarms.

To secure a high percentage of responses, temporary absences or changes in telephones over which men may be reached must be reported systematically. Lists of such variations must be kept near the telephones over which the calls are to be sent out.

This reporting of personal movements will be the most difficult thing to accomplish, even to a fair degree—first, to bring a large number of men to the point of being willing to report in; and second, to achieve any reasonable agreement as to how short an absence from the listed address should be considered worthy of report. As a matter of fact, the results secured were considered very good, since the chief object of reporting is to avoid fruitless calling of men who cannot reasonably be reached. These will constitute only a small percentage of the total at any one time. Others, absent for only a matter of minutes, will easily be caught by relayed messages.

Up to the present, no attempt has been made in the Chicago area to reshape the living habits of the city's four or five million people on a semi-military basis. But the planning is being done and it is then assumed that as a result of ordinary human reactions, the employees in any locality will respond naturally as the seriousness of the situation is brought home to them.

Table I. Results of Communications and Assembly Test of Chicago's Bureau of Sewers

Held 8 p.m. Wednesday, March 18, 1942

Squad	Yard No.	No. of Key Men	No. Men at Headquarters in ½ Hr	1 Hr	1½ Hr	2 Hr	All Reporting	Total Listed	% Assembled
A	3	16	11*	41*	60*	63*	(1 hr 40 min) 63*	80*	79*
B	3	15	*	*	*	*	*	*	*
C	2	16	4	21	29	33	(2 hr 5 min) 35	40	88
D	1	16	12†	47†	59†	67†	(2 hr 20 min) 68†	87†	78†
E	4	16	6	31	33	34	(1 hr 37 min) 34	40	85
F	1	15	†	†	†	†	†	†	†
G	4	14	1	16	21	25	(1 hr 35 min) 25	40	63
H	6	16	1	11	26	32	(2 hr 36 min) 36	40	90
I	5	16	0	18	27	30	(1 hr 36 min) 30	40	75
J	5	14	1	8	20	25	(1 hr 32 min) 27	40	67
K	7	16	8	23	32	33	(1 hr 35 min) 33	40	87
L	1	1	†	†	†	†	†	†	†
Office		22	0	11	20	25	(2 hr 30 min) 34	40	80
Total		193	44	227	327	367	385	487	80

* Squads A and B combined. † Squads D, F, and L combined.

Magazine Separation Determines Plan of Ordnance Depot

By A. C. Polk, M. Am. Soc. C.E.
Consulting Engineer, Birmingham, Ala.

Although the depot here described is mainly used for the storage of war materials and no manufacturing is done there, the task of utility layout for efficient materials handling was nevertheless quite involved. Of special interest is the engineer-contractor type of administration used for these huge Quartermaster Department projects. Mr. Polk presented this paper originally before the Construction Division at the Society's Convention in Minneapolis, Minn.

Several thousand acres of rough land, almost entirely unoccupied, was the site selected by the Government for the ordnance depot described here. The terrain was badly cut up, and approximately 360 ft in elevation separated high and low points. There was no regularity in the formation of the hills, which were fairly heavily wooded.

The engineering and construction work on this particular depot included preliminary surveys and layout, as well as final location, design, and construction. Items of the permanent work were igloo magazine areas, above-ground magazine areas, inert storage warehouse area, combat storage area, and utilities and administration area. General utilities to serve these areas, such as roads, railroads, water supply, sewage, and power service and distribution were also provided. Thus it can be seen that the engineering problems were broad and diversified.

First surveys were started in November 1940, and although no maps of the area were available, all topography, boundary lines, land ties, maps, and reports were entirely completed by the first of March 1941.

Post Headquarters at Army Ordnance Depot

The price of approximately $3.50 per acre for the completed job included studies of the sources of water and power and the preparation of the preliminary layout of the project.

Of the total area covered by the project, the larger part is occupied by several hundred igloo magazines. In general these are located in blocks of 100 with a wide clearance between blocks. Magazines in adjacent rows are staggered in their spacing so that no magazine points toward another. The terrain created a separate problem in the location of each igloo. It had to be placed on the ground within a fairly limited area, so located as to meet the grades of service roads acceptably and to comply with the minimum clearance distance.

This presented a major problem in location for there was no flat or gently rolling terrain. The main service roads, short access roads to the igloos, drainage from the igloo area, and igloo grades, all had to be considered jointly and coordinated. On this project the magazines are approximately 61 by 26 ft. They are of heavily reinforced concrete, with level floors slightly above the ground surface. Reinforcing is welded together at a number of points and carefully grounded electrically to protect against lightning strokes and static discharges. A maximum resistance of 20 ohms to the ground is the requirement for all lightning protection.

Magazine Construction

Natural ventilation of the magazines is provided to regulate moisture accumulation and keep the interior dry. Ventilators that will avoid danger from fire or from the dropping of explosives into the magazine are provided. Fusible links and weights automatically close the dampers against sparks or flames in the event of a grass or brush fire near the igloo. The main entrance door is bullet proof. After the concrete shell of the igloo is completed, it is covered with a membrance waterproofing on the exterior, backfilled with earth, and sodded.

Thirty sets of removable steel forms were used in the construction of these magazines. Pouring the concrete in the first igloos (about 200 cu yd) required about eight hours, but this time was soon cut to $2^1/_2$ to 3 hours per igloo, and the average schedule of completion was eight igloos per day. The igloos on this project were among the first to be built, and many difficulties arose in adapting the standard design to the local conditions and terrain. Many consultations with the Ordnance Department and the Quartermaster Corps, under which the work

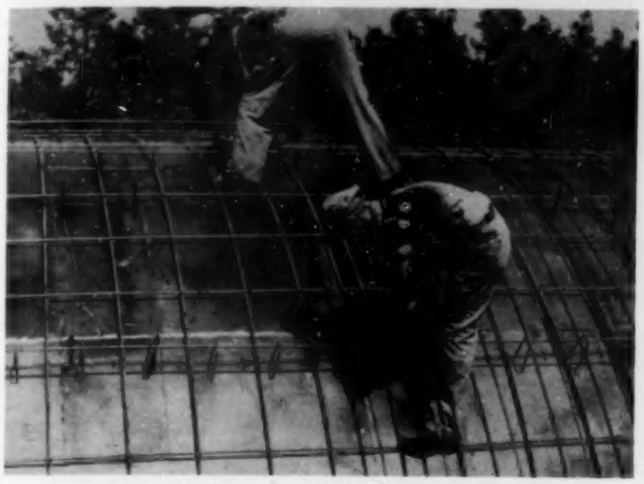
Placing Reinforcing for Igloo Floor and Walls

was being handled at that time, were necessary. A number of modifications and minor revisions were worked out and adopted, with a minimum of confusion to the work that was in progress.

The magnitude of the operations in this area is shown by the following quantities:

Excavation and grading	3,500,000 cu yd
Concrete	205,000 cu yd
Chert surfacing of roads	340,000 sq yd
Backfilling over igloos	812,000 cu yd
Membrance waterproofing	26,000 squares
Roads	125 miles

The igloo magazines are of large capacity and are served through a combined railroad and road system.



Inner Form and Reinforcing in Place for Igloo Arch

Materials are delivered by rail to a depot yard of 90-car capacity. After classification, they are delivered over a 16-mile rail system to unloading docks throughout the area. Trucks then complete the trip to the various magazines. The rough terrain did not permit serving each individual igloo by rail, hence the combination of rail and truck transportation. Several magazines for small arms ammunition are located outside the igloo area much closer to the railroad yards.

Ample clearance is provided between magazines, which are located in pairs. In this same area is another structure known as the Clipping and Belting Building, where ammunition is placed in belts and clips. Shipping

Welding Secured Continuity of Reinforcing and Eliminated Overlapping of Rods

Membrane Waterproofing Was Used for Igloos, Under the Earth Covering

and bundling buildings are also located in the vicinity of the igloo area. Here large bombs and material of a similar character are prepared for shipment. Here also is the Inspectors' Workshop, where checks are made on explosive materials. No two of these buildings are alike.

Located fairly close to the railroad yards are the warehouses for the storage of inert materials such as gun parts. All warehouses are built of concrete and brick, a majority with steel frames, a few with wood trusses, all with fireproof roofs. The area is served by rail and a concrete road, and is fully protected from fire by a complete water system. More than 6,150,000 brick, 1,098 sliding doors, and 11,000 squares of roofing were used in this area alone.

A combat storage area was added when the original project was practically completed. It is located about three miles from the original inert storage warehouse area and is served with about 11 miles of railroad trackage, including an interchange yard at the serving railroad, a main-line connection to the area, a 150-car storage yard in the area, and service tracks to its various shops and warehouses. This area required separate water supply, sewerage and power distribution systems. An optical repair shop, ordnance repair shop, ordnance shop-type warehouse, and paint and paint storage building are also in this area together with heavy cranes for handling ordnance, special unloading docks, a central heating plant, and other similar facilities.

The structures in this area had to be designed to avoid the use of priority materials as far as possible. Consequently all roof trusses are of wood, and critical materials have been eliminated everywhere possible. Provision of substitute materials proved to be a difficult but not insurmountable task.

In the administration area are located the Post Headquarters, Fire Guard House, Dispensary, Officers' Quarters, and Gate Guard House. It is served by concrete roads, and protected by a standard fire-protection system. An underground lighting system serves this area, the warehouse area, and the utilities area.

West of the administration area, are the various utility shops. Here are located the locomotive storage and repair shop, machine and carpenter shop, paint and paint storage shop, central heating plant, regimental garage, and sewage disposal plant. Here also are the truck parking lot, horse barn, incinerator, gasoline storage and dispensing equipment, and the necessary water and lighting facilities.

BULLET-PROOF AND FIREPROOF DOORS WERE PROVIDED FOR STORAGE MAGAZINES

A water system serving the inert warehouse, administration, and utilities area had to be provided. (No water is provided in the magazine area.) Arrangements were made with an existing water company for a source of supply, and a million-gallon elevated storage supply was provided on the reservation to care for domestic and fire needs. Some 35,000 ft of water line was installed.

Electric power was secured from a local company delivered at the property line. Facilities for distribution throughout the area were designed and built as part of the project. These included a boundary-fence lighting system approximately 14 miles long, as well as ample flood and other lighting in the warehouse, administration, and utilities areas, and power to the various shops.

A sewerage system and disposal plant serve the warehouse, administration, and utilities area. No other areas are served from this system. The combat storage area has identical but separate utility systems similar to those just mentioned. Its distance from the original area and the difficulties of the terrain made this necessary. Also the original layout was designed and built before it was decided to add the combat storage area, and consequently could not accommodate the additional loads, located a considerable distance away.

A four-strand barbed-wire fence surrounds the reservation. Inside this and protecting the magazine area is a wire-mesh fence 60 in. high, with a patrol road just inside it and a lighting system so located that a fairly wide area at the fence line can be observed from the patrol road. Various other minor facilities, such as railroad track scales, truck scales, main access road to the state highway, and a fire observation tower, were also laid out and constructed.

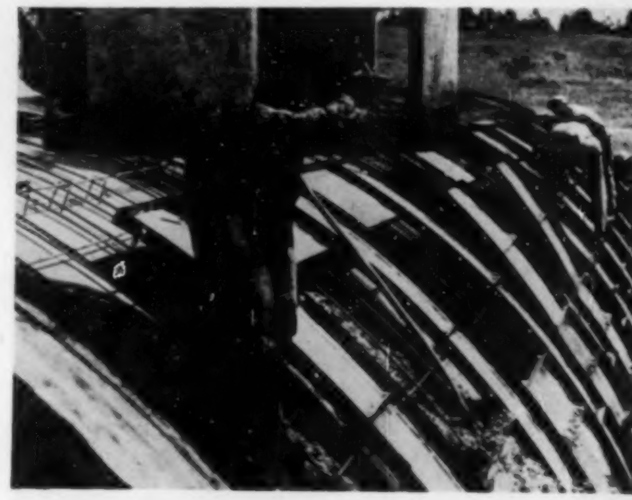
The engineers handled their work under a fixed-fee contract with the Quartermaster Department, covering the design of the project and the supervision of all construction. The engineers' forces at the peak of the job amounted to 260 employees. In general the organization was set up in the following groups:

1. Administrative group, including all clerical help, finances, reports and cost records of various kinds, contacts with Government auditing and financing group, and similar matters.
2. Designing and drafting group, together with the specifications and estimating group.
3. All field operations, divided into railroad, roads and drainage, general layout of all structures in the field, and inspection.

This type of organization seemed to function very well, and was successful in the handling of this particular project.

The Government was represented on the job by a Constructing Quartermaster, and later, when the Chief of Engineers took over, by an Area Engineer, under the District and Division Offices of the Chief of Engineers.

In the design and supervision of the technical phases of the work, we found we had to have men capable of handling many specialized lines. These included a railroad engineer experienced in the location and construction of modern railroads in rough country. Men of this type are now scarce. A capable highway engineer was also necessary, who could locate and design a most complicated road system, determine the proper specifications, and handle the explorations and laboratory tests for suitable materials of construction. Others needed were a head and assistant to take charge of all field operations and layout work; electrical engineers and designers; heating and plumbing experts; sewage disposal, sewer, and water works men with municipal and similar experience; a mechanical engineer and designers; architects; and many other minor technically skilled men.



AN AVERAGE POURING TIME OF THREE HOURS FOR EACH UNIT WAS ATTAINED

Work on the original project was started by the contractor under a fixed-fee contract on April 1, 1940, and was practically completed in February 1941, a period of approximately ten months. The combat storage area was started in April 1942 and was actually completed in October 1942.

COMBAT STORAGE AREA REQUIRED A SEPARATE SYSTEM OF UTILITIES

Plain Concrete Arches

Steel Ban Shifts Attention to the Use of Unreinforced Spans

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NOTABLE bridges in our own country and abroad demonstrate the feasibility of using unreinforced concrete for arch structures to secure both beauty and utility. A number of examples have been chosen by Mr. Whitney to illustrate the principles of design of such spans. Of special interest is the development of the three-hinged arch for use where the ratio of rise to length of span is low. This paper was originally presented before the Structural Division at the Society's Minneapolis Convention.

SINCE the use of reinforced concrete has become general, very few plain concrete arches have been built, but there is no doubt that under favorable conditions they are structurally adequate. The problem offers an interesting opportunity to combine modern design methods with many centuries of practical experience in masonry arch construction. As almost no attention has been given to this structural type during the last generation, it is my purpose here to indicate what design method should be used and to suggest types of structures for which plain arches may be suitable.

The fixed-end arch is statically indeterminate, and the reactions due to loading or volume changes should be determined for the plain arch by means of the theory of elasticity as in the case of the reinforced concrete arch. (See Final Report of Special Committee on Concrete and Reinforced Concrete Arches, Transactions, Am. Soc. C.E., Vol. 100, 1935, p. 1427; and "Plain and Reinforced Concrete Arches," report of American Concrete Institute Committee 312, by the writer as chairman, *Journal*, American Concrete Institute, September 1940.)

In analyzing the plain arch for the purpose of determining thrusts and moments, it is assumed to consist of an uncracked, homogeneous, elastic material. The fact that the concrete is actually plastic to a considerable degree is taken into account in calculating the effect of volume changes and in estimating the useful strength of the rib sections. The plastic and shrinkage strains are variables, depending on so many factors that no accurate prediction of their size is possible, but a study of tests made both in the laboratory and on actual bridges indicates what allowance should be made for them in practice.

Concrete arches usually have fixed ends and any change in the volume of the concrete affects the reactions in the same manner as a corresponding movement of the abutments. Important volume changes are produced by:

1. Dead-load rib shortening.
2. Shrinkage of the concrete.
3. Variations in temperature and moisture content.

All these changes are modified by plastic flow.

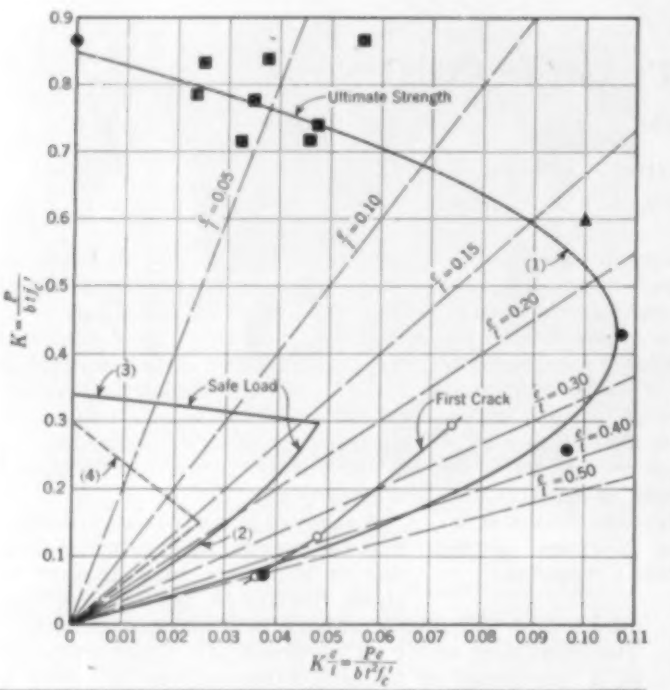
Shortening of the arch by dead-load thrust is greatly increased by plastic flow occurring gradually over a period of many months. At the same time, plastic flow releases much of the stress which would have been produced in the rib by a corresponding shortening in an elastic material. This release of stress compensates for, or neutralizes, the effect of the increase in shortening due to plastic flow so that, in so far as dead-load rib-shortening reactions are concerned, the plastic flow can be disregarded and the effect calculated as for an elastic rib. The same modulus of elasticity is used to calculate the amount of shortening and the size of the reactions.

A study of available data indicates that the shortening of a bridge arch due to shrinkage may amount to about 0.00015 in. per in., and that plastic flow will release at least 60% of its stress effect. The equivalent effect on an elastic rib would therefore be a shortening of about 0.00006 in. per in. This is equivalent to the effect of a 10 F drop in temperature with a thermal coefficient of 0.000006, or 15 F if the thermal coefficient is only 0.000004.

Shrinkage may be higher in extremely dry climates. Underground structures may show practically no shrinkage. Seasonal variations in the moisture content of bridge arches produce volume changes which may to some extent offset temperature variations if there is a tendency for the concrete to dry out during the summer months.

If proper precautions are taken to cast the arch in sections, it may be assumed that plastic flow will eliminate the effect of the temperature rise due to the heat of setting of the cement and the effect of completing the arch at a temperature above or below the mean annual temperature. The concrete becomes more elastic with age, and it is best to consider the action of the arch as fully elastic under annual temperature variations. Because of the lag between the air and arch temperatures, and for various other reasons, the temperature range in an ordinary bridge arch may be taken as 60% of the difference between the highest and lowest recorded temperature near the location of the bridge. The actual range depends on the thickness and exposure of the concrete. For underground structures this range can be reduced, and for thin exposed structures it should be increased. The thermal coefficient of expansion of con-

Filled Masonry Arch, Lorrainebruecke, in Berne, Switzerland



● Ultimate Load } Bach and Graf Tests
○ First Crack }
Report of American Concrete Institute Committee 312, 1940, Average of 3 Tests

■ Crawford and Fry Tests, *Concrete and Construction Engineering*, August 1939

▲ Slater and Lyse Tests, *Journal* of American Concrete Institute, June 1930, Average of 3 Tests

Ultimate Strength

(1) $P = 0.85btf_c'\left(1 - 2\frac{e}{t}\right)$

Recommended for Safe Load

(2) $P = 0.85btf_c'\left(1 - 4\frac{e}{t}\right)$ when $\frac{e}{t} > 0.163$

(3) $P = 0.34btf_c'\left(1 - 0.8\frac{e}{t}\right)$ when $\frac{e}{t} > 0.163$

Straight-Line Equation for Safe Load

(4) $P = \dfrac{0.3btf_c'}{6\frac{e}{t}+1}$ when $f_c = 0.3f_c'$ and $\frac{e}{t} < 0.167$

FIG. 1. STRENGTH OF PLAIN CONCRETE ARCH RIBS

crete usually is between 0.0000065 and 0.000004, and may be assumed as 0.0000055 in the absence of definite tests.

MODULUS OF ELASTICITY

It is recommended that a modulus of elasticity of 4,000,000 lb per sq in. be used for the concrete in figuring rib shortening, shrinkage, and temperature thrusts. For calculating dead-load deflections, about one-third to one-fourth of this value should be used to allow for plastic flow.

PROPORTIONING OF ARCH RIBS

Because concrete is to a considerable degree a plastic material, the straight-line formula does not predict the actual strength of a plain concrete arch section with satisfactory accuracy. In order to take advantage of the actual strength, the writer recommends the use of a new formula based on the plastic quality of the concrete and verified by tests. This formula is

$$P = 0.85\,btf'_c\left(1 - 2\frac{e}{t}\right) \qquad (1)$$

in which P = thrust causing failure, in lb
b = width of section, in in.
t = depth of section, in in.
f'_c = standard cylinder strength of concrete, in lb per sq in.
$e = \frac{M}{P}$ = eccentricity of thrust, in in., measured from center of section

In Fig. 1 the curve represented by Eq. 1 (Curve 1) is compared with the results of various tests on eccentrically loaded plain concrete rectangular sections. It gives the ultimate strength of the rib as $0.85f'_c$ times twice the area between the load plane and the nearest face of the section. It also shows, for the full range of eccentricity, the combinations of thrust and moment which will cause failure. This permits special consideration in designing the section to be given to the effect of increase in either thrust or moment separately. This has not been customary but it is important because high arch thrusts are not due to the same causes as high moments, and either may exist without the other.

The standard method of arch design, using working stresses and a factor of safety, assumes that in case of an overload both moment and thrust increase proportionately and the eccentricity remains constant. This is not a safe assumption, as Fig. 1 shows that a rib may fail at a much lower moment if the thrust does not increase in proportion to the moment.

It is therefore recommended that consideration be given to the effect of increase in thrust and moment separately by keeping the calculated values within the limits bounded by Eqs. 2 and 3, as follows:

$$P = 0.85\,btf'_c\left(1 - 4\frac{e}{t}\right) \qquad (2)$$

which applies when e/t is greater than 0.163 and provides that the strength of the rib will equal the effect of the maximum thrust and twice the maximum moment.

$$P = 0.34\,btf'_c\left(1 - 0.8\frac{e}{t}\right) \qquad (3)$$

which applies when e/t is less than 0.163 and provides that the strength of the rib will equal the effect of $2^1/_2$ times the maximum thrust combined with the maximum moment.

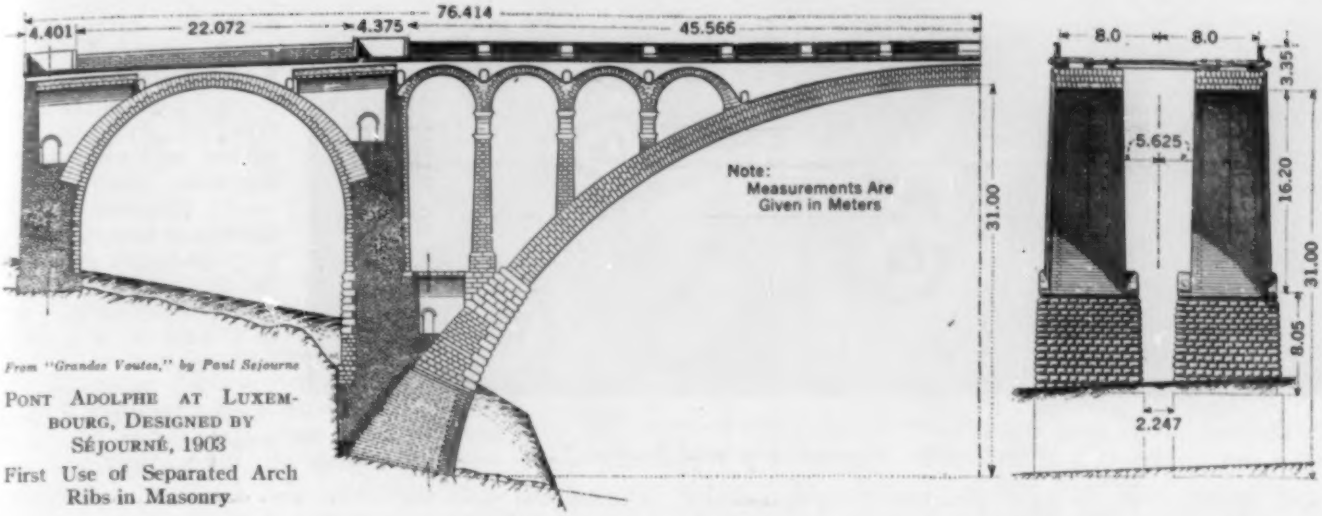
A factor of 2 is used for the moment instead of $2^1/_2$, because the maximum moment includes the effect of volume change, which does not greatly reduce the ultimate load-carrying capacity. It is, however, important to consider the effect of volume change in order to prevent cracking in service and to avoid excessive foundation movements.

Equations 2 and 3 represent the safe, useful strength of the rib for comparison with the moments and thrusts calculated by means of the elastic theory, which gives conservative values under working conditions. These two equations are shown in Fig. 1, compared with the straight-line equation for safe load,

$$P = \frac{0.3\,btf'_c}{6\frac{e}{t} + 1} \qquad (4)$$

In this equation, which represents present standard practice, the allowable stress is assumed to be $0.3f'_c$, and e is not permitted to exceed $t/6$ in order to prevent tension from entering the section.

It should be noted that the Bach and Graf tests show the first crack appearing at much higher moments than



Pont Adolphe at Luxembourg, Designed by Séjourné, 1903

First Use of Separated Arch Ribs in Masonry

would be permitted by Eq. 2. The proposed method using Eqs. 2 and 3 indicates the safe, useful strength of the arch rib to be much greater than the strength recognized by Eq. 4, and shows that the eccentricity need not be limited to one-sixth of the depth of the rib.

TENSILE STRESS IN THE CONCRETE

While it is not recommended in general that dependence be placed on the tensile strength of concrete in an unreinforced arch, it may be reasonable to design some structures subjected to relatively very small live load on the basis of uncracked section allowing a small tensile stress in the concrete. For instance, this might be done in the case of concrete igloos under favorable conditions where a crack in the arch would only cause a redistribution of earth pressures without collapse. It should be kept in mind that any concrete structure of any size may crack for reasons other than theoretical loading stresses. It is interesting to note that the first crack appeared in the Bach and Graf tests (Fig. 1) when the theoretical tensile stress (straight-line stress distribution on uncracked section) was about $0.15 f'_c$.

Because the moments and thrusts for which a fixed-end arch must be designed are dependent on the proportions of the rib, the best proportions can only be found by successive trials. The ordinary procedure of assuming a design and proving by analysis that its strength complies with the specification is not sufficient to assure proper proportioning. Because of the great number of variable factors involved, it is not possible to write a simple equation for proper crown and springing thickness. To get the best solution, the effect of various combinations of thickness must be considered.

This is especially true in the case of a plain concrete bridge arch with a low ratio of rise to span length because of the importance of the volume change moments. These moments increase with the thickness of the rib so rapidly as to more than offset the reduction in effect of dead and live loads after a certain thickness is reached. In other words, if the rib thickness is plotted against the theoretical stress, it will be found that one thickness will give a minimum combined stress and that either an increase or a decrease in thickness will increase the stress.

In the case of a reinforced arch, it is possible to reduce the effects of volume changes by increasing its flexibility through the use of a more heavily reinforced but thinner rib. Assuming a plain arch loaded to capacity, it can only be made thinner and more flexible by increasing the strength of the concrete. The allowable span and rise of a plain concrete arch of a certain thickness will be limited by the strength of the concrete, and the limiting values can only be found by detailed calculations involving all specified conditions.

The problem is complicated by the fact that the moments depend not only on the thickness of the rib but on its relative thickness at crown and springing line. Critical bending usually occurs at the springing line, so that it must be thicker there than at the crown. At the same time it is important to avoid excessive springing thickness which will cause excessive moments.

To make possible the rapid analysis of a number of comparative arch ribs, diagrams and tables have been prepared giving the thrusts and moments due to vertical loads, rib shortening, shrinkage, and temperature changes for arches in a complete range of assumed proportions. ("Design of Symmetrical Concrete Arches," by the writer, Transactions, Am. Soc. C.E., Vol. 88, 1925, p. 931; and *Concrete Designer's Manual*, pp. 219–264, by G. A. Hool and the writer, McGraw-Hill Book Company, 1926.) Equations have also been derived for horizontal loading but have not yet been published. This material is based on an accurate mathematical solution and can be used for final design as well as preliminary calculations.

USE OF PLAIN CONCRETE ARCHES

Plain concrete arches are suitable only when the eccentricity of the arch thrust is comparatively small. This requires that the dead load be large compared to the live load and that the volume change moments shall not be excessive.

They may be used for underground structures such as igloos, conduits, culverts, and tunnel linings. In such cases, the earth cover provides a heavy dead load and the volume-change moments are low because of comparatively stable temperature and moisture conditions. Igloos could be either barrel or dome shaped. Care must be taken in placing the earth covering to avoid excessive bending, and it may be well to keep shoring below the arches while the fill is being placed. Sandy soil which drains easily is desirable for backfill, as its rigidity helps to reduce the bending in the arch. The arch axis should follow the pressure line of dead load as closely as possible.

Plain concrete can be used for the arches of large heavy bridges when the rise-span ratio is sufficiently great to avoid excessive volume-change moments. Spandrel-filled arches usually have a high dead-load to live-load ratio, but they present special problems. The weight of the fill on the arch and its thrust against the spandrel

WALNUT LANE BRIDGE IN PHILADELPHIA, 1908
Plain Concrete Arches and Reinforced Roadway

walls usually limit the use of that type to comparatively short, flat spans. The low rise necessitates careful study of the effect of volume-change moments especially near the springing line of the arches, where the eccentricity of the thrust is usually greatest. The spandrel walls must be designed to resist the lateral thrust of the fill, and to have sufficient flexibility to avoid cracking. They must not cause excessive stress in the arch from cross bending.

One of the most important requirements in the design of the roadway and superstructure of the span above the arch is that it be given sufficient flexibility to follow the movements of the arch without cracking and without unduly restraining the arch. Plain concrete is not especially well suited to this purpose, and, where possible, consideration should be given to the use of reinforced concrete, steel, or timber decks. A number of large bridges have been built with plain concrete or stone masonry arches and reinforced concrete roadways. It is possible in that way to reduce the total amount of reinforcing steel to a comparatively small quantity.

That bridges can be built entirely of plain concrete is evidenced by many stone masonry structures erected in the eighteenth and nineteenth centuries. The record of these bridges is the most valuable source of information as to how such bridges should and should not be built. Such a record will be found in Paul Séjourné's six-volume work *Grandes Voutes* (Bourges, France, 1912–1916), which covers most of the important arch bridges built in the world prior to 1912. The descriptions of difficulties and failures are particularly valuable. In studying these bridges it must be remembered that many of them were built where the climate is mild and uniform, and that some of the successful designs would not be suitable in severe climates.

MASONRY HAS CERTAIN FLEXIBILITY

It is also necessary to consider the fundamental differences in the characteristics of stone masonry and plain concrete. Masonry, consisting of stones separated by mortar joints, has a certain degree of flexibility or adjustability not possessed by monolithic concrete. The concrete should be cast in blocks to reduce the effect of shrinkage. Enough joints should be provided in the superstructure to permit the volume-change movements without signs of distress.

In general, three devices have been used to provide a level roadway over a masonry arch without the use of steel reinforcement:

1. The simplest method, when the height from arch to roadway is not too great, is the use of a fill of some material which can be easily drained and which will not exert an excessive lateral pressure against the solid spandrel walls. An example of this type is the Lorrainebruecke in Berne, Switzerland. Gravel, dry stone rubble, and even lean concrete, have been used. Concrete fill is dangerous because it is not sufficiently flexible. In the case of large spans, the great weight of a solid fill is a disadvantage.

2. For large spans, the weight of the superstructure has been reduced by the use of longitudinal walls supporting two or more longitudinal vaults. This construction does not provide very satisfactory flexibility because of the continuous walls. The 200-ft arch at Chester, England, built in 1834, and the Main Street Bridge in Wheeling, W.Va. (1892), were of this type.

3. A still lighter and more satisfactory construction for large spans consists of transverse piers, supporting short-span arches over the main arch. This eliminates the solid spandrel walls and gives greater flexibility. This type has developed into the modern open-spandrel bridge. A typical example is the Pont de Lavaur, a French railroad bridge of 200-ft span, built in 1884.

Various combinations of the three methods have also been used. It is obvious that the proper articulation of a superstructure of plain concrete requires great care no matter what system of construction is adopted.

An interesting detail was used to provide flexibility in the bridge at Morbengo, Italy, built in 1903. The jack arch over the springing line was built with granite hinges and open joints in the masonry above. The steel hinges in the main arch of 230-ft span functioned only until the span was completed, at which time they were filled with cut stone.

Perhaps the most important stone arch bridge was the Pont Adolphe at Luxembourg, designed by Séjourné and completed in 1903. The arch span is 278 ft and this is the first example of the use of two separated arch ribs in masonry. It is in effect two bridges side by side with a slab of reinforced concrete spanning between to complete the roadway (see illustration).

Immediately after completion, Séjourné's bridge at Luxembourg served as a model for the design of the Walnut Lane Bridge in Philadelphia (shown in an accompanying photograph). In that bridge, finished in 1908, the arches are plain concrete and the roadway is reinforced with steel beams and rods. (See "Walnut Lane Bridge," by George S. Webster and Henry H. Quimby, TRANSACTIONS, Am. Soc. C.E., Vol. 65, 1909, p. 423.) The Rocky River Bridge at Cleveland, completed in 1910, is of similar design.

Another development of interest is the use of three-hinged arches of stone masonry or plain concrete where the rise-span ratio is too low to permit the use of fixed arches. There are a number in which plain concrete or granite hinges have been used, the longest being the 200-ft span at Göhren, Saxony. These hinges were of the rolling type, presenting concave and convex cylindrical surfaces in contact. The problem of superstructure articulation is comparatively simple when flat three-hinged arches are used. The use of reinforced concrete hinges might be preferable to plain concrete or granite.

Measurements of Pore-Water Pressure in Silt and Clay

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Pore-water pressure has been measured by a number of methods of varying reliability. Recognizing the importance of this quantity in many computations, Dr. Terzaghi has analyzed the current methods for their relative dependability and ease of application. Here he describes the use of the elastic-wire strain meter to determine these pressures and discusses the results of field tests that have been made with the device.

Pore-water pressure appears in every computation concerning the stability of earth dams, the settlement due to consolidation of silt or clay strata under load, the safety of shipway floors with respect to heave, and in many other computations pertaining to the design of structures consisting of fine-grained soils or located above such soils. A preliminary estimate of the initial value and rate of decrease of the pore-water pressure can be made on the basis of the results of laboratory tests. However, such estimates are seldom accurate enough to eliminate the necessity for subsequent verification by measurements in the field, during and after construction.

Experience with current methods for determining pore-water pressure in clay led to the conclusion that a new type of measuring device was needed. For instance, Bourdon gages should be used only if the hydrostatic head at the gage is always positive. If the observation point (point at which the pore-water pressure is to be measured) is located in fine silt or clay, insignificant leaks in the joints of the system render the gage useless, and the prevention of such leaks is a difficult problem. Changes in temperature have a considerable effect on the readings under constant hydrostatic pressure in the clay. As for observation wells, they are unsuitable for use in silt or clay. The readings on Goldbeck cells depend on the rate at which the air pressure on the membrane is increased, and on other factors which are difficult to control. The importance of the inevitable errors increases rapidly with increasing fineness of the soil.

Strain-Meter Gage Developed

In order to be able to measure the pore-water pressure by means of an instrument that can be installed at any elevation above the piezometric level, and to reduce the time lag of the recorded pressure due to the low permeability of the soil to a tolerable amount, the writer experimented with a device equipped with a Carlson elastic-wire strain meter. In this device the water pressure acts on a steel membrane located $1^1/_2$ ft above the observation point, and the readings are made on a Wheatstone bridge which is connected with the strain meter by means of a three-conductor Tyrex cable.

Results of the experiments with this strain-meter gage were so encouraging that the writer felt justified in recommending the installation of gages of a slightly modified type on several jobs. The observations that were to be made with the gages included the measurement of the pore-water pressure in the core of an existing hydraulic-fill dam, and of that in beds of plastic clay located beneath a site for ore storage.

A study of the three methods of determining pore-water pressure previously mentioned, has led to the following conclusions regarding the conditions necessary for their successful use. The well-known Bourdon gage has the important property that the increase in the amount of water enclosed in the conduit between the soil and the gage, due to a change of the water pressure, is extremely small. As a consequence, the gage reacts almost instantaneously to a change in the pore-water pressure, provided that there is no air in the conduit between the soil and the gage. However, a change in temperature at the site where the gage is installed changes the reading at a constant pore-water pressure, and the error due to temperature effects can be rather important.

The gage is mounted at the upper end of an extra heavy 1-in. or $1^1/_2$-in. steel tube. The lower end (contact end) of the tubing is located at the observation point in

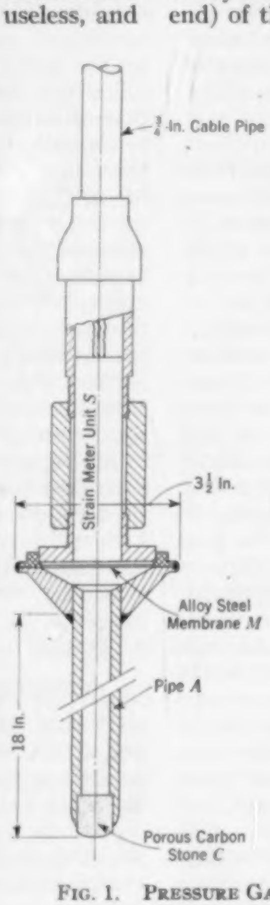


Fig. 1. Pressure Gage with Elastic-Wire Strain Meter

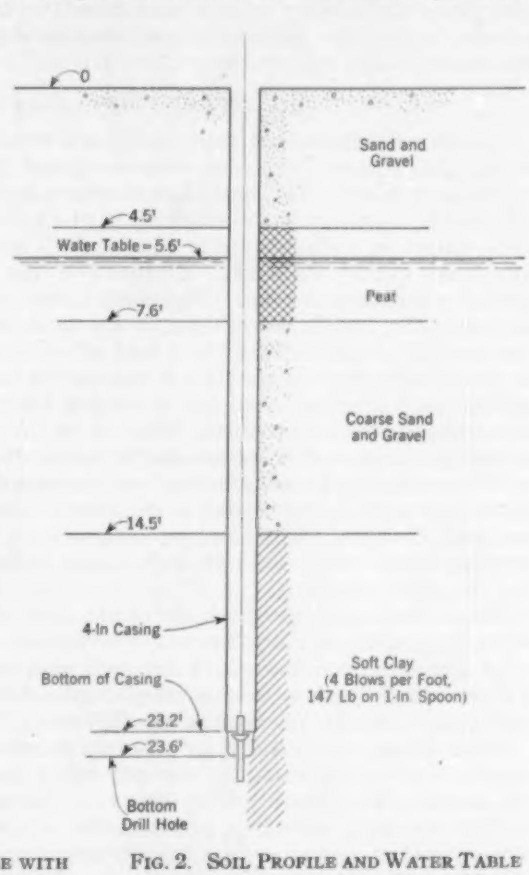


Fig. 2. Soil Profile and Water Table at Site of Field Tests in Lynn, Mass.

the soil. Few of the installations in which the gage was placed above the lowest piezometric level have proved to be successful. Therefore, as previously stated, the Bourdon gage should not be used unless it can be installed below this level.

On the Chicago Subway, Bourdon gages were used for measuring the pore-water pressure in plastic clay adjoining the tunnel tubes. The contact end of each piezometric tube was plugged with a porous carbon stone with a coefficient of permeability of about 4×10^{-3} cm per sec. The pipe, while being transported from the laboratory into the tunnel, was filled with water and the contact end was sealed with a rubber cap.

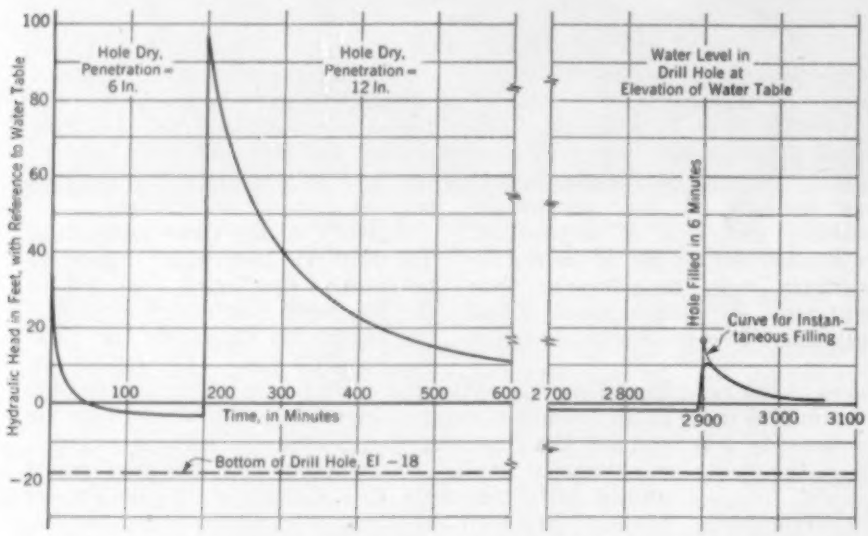


FIG. 3. RELATIONSHIP BETWEEN HYDRAULIC HEAD AND ELAPSED TIME, IN LYNN, MASS., FIELD TESTS

DIFFICULTIES WITH BOURDON GAGES

In order to make sure that the joints were perfectly watertight, the entire system was assembled and tested in the laboratory. The tests showed that it is practically impossible to assemble the elements of the system at the very outset in such a manner that it does not develop any leaks during the tests. Stopping of the leaks required patience and care. Therefore it was considered necessary to install the system in the ground without temporarily disconnecting the joints after the final test in the laboratory. Even then it was not possible to be certain that new leaks had not developed while the pipe was being forced into the soil. If the pipe is very long it is always necessary to disconnect the joints after testing, and the prospects for establishing and maintaining watertight joints when the system is reassembled in the field are rather slight. Yet even an insignificant leak in a conduit whose lower end is located in clay suffices to render the gage useless.

If the observation point is located in a mass of clay in a state of progressive consolidation, the contact end of the pipe advances in a downward direction with reference to the surrounding clay, because the length of the pipe is constant, while the thickness of the bed of clay decreases. This movement is likely to increase the pore-water pressure in the clay adjoining the contact end of the pipe, but the importance of the resulting error is not known.

The preceding statements lead to the conclusion that the success of Bourdon-gage installations for measuring the pore-water pressure in silt and clay depends on several factors which are difficult to control. The installation in the field requires painstaking supervision, and the accuracy of the results is by no means certain.

SHORTCOMINGS OF OBSERVATION WELLS

The second current method of determining pore-water pressure is by observation wells, which have been installed on various occasions in soft consolidating clays with the intention of measuring the excess hydrostatic pressure. The wells actually did indicate the existence of such a pressure. However, the water in the well cannot rise unless an appreciable quantity of water flows out of the clay into the well and vice versa. In soils with a low permeability, the hydraulic gradient required to produce this flow is very important. Therefore, in such soils, the hydrostatic pressure conditions at the bottom of the well are very different from those that existed at the same locality before the well was installed, and the well readings cannot be relied upon.

LIMITATIONS OF GOLDBECK CELLS

In an attempt to eliminate the shortcomings of observation wells, the U.S. Bureau of Reclamation designed the third device to be discussed here—a pressure cell on the principle of the Goldbeck cell. Many cells of this type have been installed in earth dams.

When a reading on a Goldbeck cell is made, compressed air is introduced into it and the pressure is read as soon as it breaks the electric contact between a flexible membrane and a stationary lug. The water displaced by the deflecting membrane can only escape into the soil which surrounds the cell. Under laboratory conditions this deflection is very small. Under field conditions condensing moisture is likely to foul the contact point, thus increasing considerably the deflection required to break the contact. If the soil surrounding the cell is relatively permeable this condition is almost without consequence. On the other hand, if the cell is embedded in plastic clay, even the readings on a cell in perfect working condition cannot be relied upon, because the air pressure required to break the contact is a function of the rate at which the pressure is applied. The fouling of the contact point increases the error due to the time effect. Yet once the cell is buried in the soil, the observer has no way of recognizing the existence of fouling.

All the favorable reports that have come to the writer's attention concerning the performance of the cell under field conditions refer to instances in which it was embedded in relatively permeable soil. An attempt to use it for measuring the pore-water pressure in a plastic clay would be, to say the least, an experiment with doubtful outcome. Therefore the writer would not even consider suggesting its use in this material.

PRESSURE GAGE WITH ELASTIC-WIRE STRAIN METER

During the first part of this year the writer was compelled on several jobs to measure the pore-water pressure in silt and clay under conditions that excluded the use of Bourdon gages. In order to solve his problems he designed the gage shown in Fig. 1, which has most of the desirable features of the Bourdon gage without its limitations and shortcomings.

The gage consists of a thin steel membrane, M, with a diameter of about $2^1/_2$ in., whose deflections can be

measured by means of a Carlson strain meter. The space beneath the membrane is completely filled with water, which communicates with the pore water in the soil through a 1-in. pipe A, and the voids of a porous carbon stone C, located at the end of the pipe, as shown in Fig. 1. The strain meter S is installed in a cylindrical container above the membrane. It consists of two concentric steel-wire coils mounted on porcelain spools on a steel frame. The coils are immersed in castor oil. A deflection of the membrane increases the tension in the wires of the inner coil and reduces the tension in the outer coil. The change in tension changes the electric resistance of the wires. The ratio between the electric resistance of the two coils can be determined above ground by means of a special Wheatstone bridge. The bridge is connected with the strain meter by means of a three-conductor Tyrex cable. Below the ground surface the cable may be encased in a $^3/_4$-in. pipe whose lower end is fastened to the top of the strain meter container.

For the gage described in this paper, the least reading on the Wheatstone bridge corresponds approximately to 1 ft of hydrostatic head. A change of 10 ft in the hydrostatic head of the water below the membrane produces a maximum deflection of about 0.0003 in. Hence the quantity of water that flows out of the soil into the membrane cup during a change of head is extremely small, and the corresponding lag between real and measured head is insignificant.

PROCEDURE FOR PLACING THE GAGE

The space below the membrane is filled in the laboratory with water under vacuum. After this has been done and the porous stone is saturated, the lower end of the pipe A is sealed with a rubber cap and the cap is not removed until the drill hole is ready for the introduction of the gage.

In order to install the gage in the ground, a 4 or 6-in. drill hole is sunk to within $1^1/_2$ ft of the depth at which the porous stone C is to be placed. While the last part of the hole is being drilled, the water level in the hole is maintained at or above the water table. This measure should reduce the tendency of the soil to rise into the casing.

Blows on the push pipe, or other violent efforts to accelerate the penetration of the pipe A into the ground must be avoided because they are likely to shift the zero point, and may even injure the strain meter.

The last step consists in sealing the gage and recovering the outer casing. To seal the gage the drill hole is filled to a height of about 2 ft with portland cement mortar and the remainder with a heavy thixotropic clay slurry. During the operation of filling, the outer casing is pulled in installments. The most important requirements for the clay slurry are that it should be less permeable than the surrounding soil and that it should stiffen up to some extent without becoming rigid. These conditions can be satisfied by an admixture of Bentonite or of suitable chemicals.

EXPERIENCE WITH FIELD TESTS

In order to find out to what extent the new gage can be relied upon under operating conditions, various tests were made in the field prior to the permanent installation of such gages on jobs. The diameter of the pipe A which was used in these tests was $1^1/_2$ in. as compared with 1 in. on the standard gages.

The first tests consisted in pushing the gage into the soft mud of the Charles River in Cambridge, Mass., down to a maximum depth of 22 ft below water level, and in determining the hydrostatic head at different depths by means of the Wheatstone bridge. The tests showed that the gage reacts instantaneously to a change in hydrostatic pressure due to pushing the gage deeper into the mud, and that the results of the readings are as reliable as those obtained in the laboratory, provided they are made after the temperature of the gage has become equal to that of the surrounding soil. This equalization required about one-half hour for every position. The water pressure was found to increase in simple proportion to the depth below the free water level. It was unaffected by the pressure of the mud.

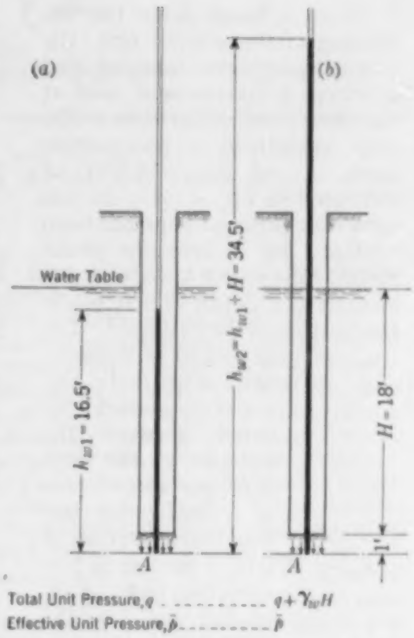


FIG. 4. CONDITIONS OF THIRD SERIES OF FIELD TESTS IN LYNN, MASS.
(a) Drill Hole Empty (b) Drill Hole Filled

A second set of tests was made on the bottom of a 4-in. drill hole in Lynn, Mass. The soil profile and the position of the water table are shown in Fig. 2. The clay was plastic, fairly homogeneous, and medium stiff. On the evening before the test was made, the water was bailed out of the hole until not more than 1 or 2 in. remained. During the night this depth did not noticeably increase. The following morning, the rest of the water was sponged out. The percolation of water out of the clay into the hole involved a hydraulic gradient towards the bottom of the hole, where the piezometric head was practically equal to zero. Beyond the range of influence of the well the elevation of the piezometric level was 18 ft above the bottom of the hole.

CARBON STONE PUSHED INTO CLAY

The first test of the Lynn series consisted in pushing the carbon stone C, Fig. 1, to a depth of 6 in. into the clay below the bottom of the drill hole. This was accomplished by one laborer throwing his whole weight on it. In accordance with the theory of consolidation, the rapid application of a pressure on the clay by pushing the tool into it produced an excess hydrostatic pressure in the pore water of the clay. As the water content of the clay adapted itself to the changed stress conditions, the excess pressure disappeared and the hydrostatic pressure at the point of observation became constant, as indicated by an unbroken curve on the left-hand side of Fig. 3. In this figure the abscissas represent the time and the ordinates the hydraulic head h with reference to the water table. At any point the piezometric head h_w is equal to the sum of the hydraulic head h and the vertical distance between the point and the water table. The curve has the shape of a simple consolidation curve.

The second test consisted in pushing the carbon stone 6 in. deeper into the clay. For this operation the weight of two laborers was required. The initial excess hydrostatic pressure was greater, and the rate of decrease of this pressure was smaller, than in the first test (middle part of Fig. 3).

About 5 hours after the beginning of the second test, the excess hydrostatic pressure had practically disappeared, and at the point of observation the gage registered a piezometric head, h_{w1}, of about 16.5 ft, as indicated in Fig. 4 (*a*). In this figure the pressure gage has been replaced by a fictitious piezometric tube whose lower end A is located at a depth of 1 ft below the bottom of the drill hole. Let

γ_w = unit weight of water
q = weight of soil (solid and water combined), located between the bottom of the drill hole, per unit of area of a horizontal section through point A
h_{w1} = 16.5 ft = measured piezometric head at A, at the end of the second test
p_e = effective pressure at A on a horizontal section through A

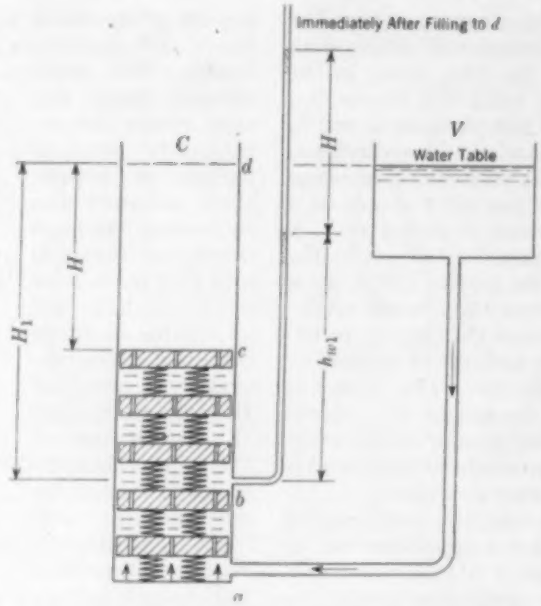


FIG. 5. A SYSTEM OF PERFORATED SPRING-SUPPORTED PISTONS, ILLUSTRATING MECHANICS OF PROCESS WHICH TOOK PLACE IN THE CLAY DURING THIRD SET OF FIELD TESTS IN LYNN, MASS.

The effective pressure is equal to the difference between the total pressure and the pore-water pressure, whence,

$$p_e = q - \gamma_w h_{w1} \qquad (1)$$

Since q was very small, the effective vertical pressure at A was negative. In other words the pore-water pressure had a tendency to force the clay into the casing.

The third and most interesting test was the following. After the conditions illustrated by Fig. 4 (*a*) were established, the drill hole was filled with water to the elevation of the water table as shown in Fig. 4 (*b*), and the readings were repeated. The weight of the column of water with a height, H, of 18 ft, which was introduced into the hole, increased the total vertical unit pressure at A from q to $q + \gamma_w H$. If the filling of the hole could be accomplished instantaneously, the water content of the clay would remain unchanged while the hole was being filled. As a consequence the effective pressure (p_e, Eq. 1) would not change. The pore-water pressure u is equal to the difference between the total unit pressure, $q + \gamma_w H$ and the effective pressure p_e, or

$$u = q + \gamma_w H - q_e = q + \gamma_w H - q + \gamma_w h_{w1} = \gamma_w(H + h_{w1})$$

The corresponding piezometric head is

$$h_{w2} = \frac{u}{\gamma_w} = h_{w1} + H = 16.5 + 18 = 34.5 \text{ ft.}$$

Hence, during the time that the hole is being filled, the gage should register an increase in the piezometric head from 16.5 to 34.5 ft.

For the mechanics of this process see Fig. 5, which represents a system of perforated spring-supported pistons occupying the lower part of a cylindrical vessel C. Water flows from a tank V into the space below the lowest piston and percolates through the holes in the pistons in an upward direction. At the outset of the test the water level in C is maintained at c and the piezometric head at b is h_{w1}. When the vessel C is suddenly filled with water to the level of d, which is located at the elevation of the water level in V at elevation H above c, the piezometric head at b increases simultaneously by H. As time goes on, the piezometric head at b decreases and finally becomes equal to H_1. This process represents a gradual consolidation of the system, because the pressure in the water decreases and the pressure on the springs increases, while the sum of the two pressures remains constant.

DRILL HOLE FILLED WITH WATER

A similar process takes place in the clay beneath the bottom of the drill hole shown in Fig. 4, if the hole is suddenly filled with water to the elevation of the water table. On the right-hand side of Fig. 3 this process is indicated by a dotted line. Since the observation point is located at a depth, H_1, of 19 ft below the water table, the sudden increase of the piezometric head from 16.5 to 34.5 ft corresponds to a sudden increase of the hydraulic head with reference to the water table from -2.5 to $+15.5$ ft. The sudden rise is followed by a gradual decrease of the hydraulic head from 15.5 ft to zero.

In reality the filling of the hole with water required 6 minutes. During the period of filling a small amount of consolidation took place. Therefore the highest measured pressure should be somewhat lower than 34.5 ft. The results of the observations represented by an unbroken line show that the gage registers faithfully even a very rapid change in the pore-water pressure.

While the gage is being withdrawn after the test, the clay which surrounds the pipe A (Fig. 1) is subject to tension and the effective pressure remains unaltered. Therefore the pore-water pressure should temporarily become negative. As a matter of fact, immediately after the pipe was pulled up $^3/_4$ in., the gage registered a piezometric head of -26 ft, corresponding to a hydraulic head of -45 ft.

The first permanent gage of the type shown in Fig. 1 has been installed in the harbor of New York, in Hudson River silt. The most delicate part of the gage is the steel membrane. In order to simplify the process of manufacturing the cell and to reduce the risk of injuring a vital part by rough handling during installation in the field, Professor Carlson designed a modified type which promises to combine the sensitivity of the gage shown in Fig. 1 with a more robust constitution.

The writer is indebted to Prof. Roy Carlson, Assoc. M. Am. Soc. C.E., of Massachusetts Institute of Technology, who built the gage in accordance with the general design prepared by the writer. In this connection the writer benefited by the persistent and successful efforts which Professor Carlson has expended during the past decade in improving his elastic-wire strain meter. He is also indebted to H. A. Mohr, M. Am. Soc. C.E., District Manager for the Raymond Concrete Pile Company, for generous cooperation in the field work required for testing the new gage. The field tests were made by John Lowe, Jun. Am. Soc. C.E., Instructor in Soil Mechanics, at M.I.T., who was retained by Amitas Ltd. in New York for this purpose. Installation of the gages on various jobs in the United States is being carried out by the Raymond Concrete Pile Company of New York.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Basic Training for Timber Designers Essential in Present Emergency

DEAR SIR: I have read with much interest Professor Hansen's article, in the November issue, on the need for trained timber designers. As he so clearly states, the design of timber structures during the past fifteen or twenty years has been practically revolutionized by the practical application of technical information developed experimentally by such agencies as the Forest Products Laboratory at Madison, Wis., and others. Previous to the use of modern timber connectors such as those developed by the Timber Engineering Company of Washington, D.C., any designer in wood was seriously handicapped in efforts to handle economically the various problems in joint detailing produced by the development of high shear and bearing concentrations at such points.

However, the writer would like to stress the point that any timber designer in order to get maximum economy and safety out of the various applications of timber to structural uses should have, in addition to a competent knowledge of structural mechanics, a thorough understanding of wood—from its growth in the forest through the seasoning and grading processes until it reaches its finished form.

In practically no other material is the designer faced with as great a variety of choice as in wood. A thorough knowledge of the botanical history of wood, its physical, mechanical, and chemical characteristics, as well as great familiarity with timber-grading rules and sizes will enable him to select for his particular use a wood that will give a maximum of economy, strength, and life.

The writer fully agrees with Professor Hansen in his contention that more attention should be given to wood as a structural material in the various colleges of the country. The idea that wood is a temporary material is an error based on misconception and lack of knowledge. A trip through New England and similar regions, where the first settlements in the country were made, will show many examples of timber dwellings, churches, and meeting houses that are several hundred years old and still in as good condition as when they were built. A number of old timber highway bridges are still in use, though built over a hundred years ago.

However, it must be remembered that to get the most out of timber structurally, the designer should have a well-rounded knowledge of wood as a material, familiarity with species and grades, and a knowledge of the proper methods of maintenance and preservation of timber in structures.

JOHN M. MONTZ, M. Am. Soc. C.E.
Associate Professor of Civil Engineering,
Columbus, Ohio *The Ohio State University*

Forum on Professional Relations

Conducted Column of Hypothetical Questions, with Answers by Dr. Mead

During the past several months Dr. Mead has been answering questions on engineering ethics in these columns. Herewith he gives his views on the question of whether a young sales engineer should, in a certain situation, put his company or his client first. This question, announced in the November number as Question No. 4, states that, "A sales engineer of a certain manufacturing company is sent out to determine the needs of a certain installation for a prospective customer. He finds that a definite type is required and knows that the only machine, similar to the desired type, manufactured by his firm is not correctly applicable and will probably make the installation unsatisfactory and there is not time enough to design a special machine. However, he also knows a competitor, whose machine would exactly fill all requirements. Should the engineer recommend the machine made by his company or the machine manufactured by the competitor? Does the client or his company come first?"

THE basis of substantial success for any individual, manufacturing concern, or supply company is the establishment of a reputation for reliable and satisfactory achievements. The best advertisement that can be secured is a satisfied customer or client. If the customer's aims are realized, the customer becomes permanent and may be relied upon both to continue his patronage and to spread the company's good reputation thus established. Those who have succeeded in establishing the most substantial reputation for satisfactory service have often adopted the principle that "the customer is always right," and in consequence have even submitted to some imposition in order to maintain the valuable reputation of "uniform satisfactory service."

No engineer or manufacturer can afford to supply any service that will not be fully satisfactory and the best that he is able to furnish. The immediate and temporary profit which may be realized from any unsatisfactory service can never be sufficient to warrant the loss of reputation that will always result from such service. A dissatisfied customer who has not received the service, machinery, or supplies, which will fulfill his needs, is a heavy liability. Work machinery, or supplies, which have been furnished and which are not satisfactory to the client or customer, assure not only the loss of further employment or patronage by the disappointed customer, but assure also the spread of information concerning the unsatisfactory service to all who are interested in securing satisfactory service along similar lines.

In the opinion of the writer, the sales engineer after discussing the matter with his employer should at least inform the customer that his company cannot within the time limit furnish machinery which will satisfactorily fulfill the conditions. The writer further believes that any assistance which can be furnished to assure the successful fulfillment of the customer's needs assures the appreciation of the customer and further consideration when other services are needed. The company by whom the sales engineer is employed is entitled to his loyal support, but such loyalty does not extend to misrepresentation; or to the rendering of unsatisfactory service for an immediate profit; or to the performance of any other form of unethical conduct.

D. W. MEAD, Past-President and Honorary Member Am. Soc. C.E.
Madison, Wis.

Similar problems of professional relations will be treated by Dr. Mead each month. Next in sequence, for study and written discussion by members until February 5, with answers in the March issue, will be the following:

QUESTION NO. 6: *A young engineer employed by an engineering firm has had extensive experience in virtual charge of a large piece of important work that was being done for one of the firm's clients. Recognizing the fact that he would be of considerable value to the client because of his detailed knowledge of the work under construction, he applied for a position which finally was offered him at a higher salary than that which he was receiving from the engineering firm. Is he justified in applying for and accepting such a position?*

Ninetieth Annual Meeting

Engineering Societies Building, New York, N.Y., January 20–21, 1943

Business Meeting, Prize Awards, Conferring of Honorary Memberships

WEDNESDAY—January 20, 1943—Morning

9:00 **Registration in the Lobby**

10:00 **Ninetieth Annual Meeting called to order in the Auditorium (third floor) by**
E. B. Black, *President, American Society of Civil Engineers*

Report of the Board of Direction

Report of the Secretary

Report of the Treasurer

10:30 **Presentation of Society Medals and Prizes**

The Norman Medal to Karl Terzaghi, *M. Am. Soc. C.E., Lecturer, Harvard University,* Cambridge, Mass., for Paper No. 2099, "General Wedge Theory of Earth Pressure."

The J. James R. Croes Medal to Charles F. Ruff, *M. Am. Soc. C.E., Sanitary Engineer, Caribbean Architect-Engineer,* New York, N.Y., for Paper No. 2126, "Maximum Probable Floods on Pennsylvania Streams."

The Thomas Fitch Rowland Prize to Shortridge Hardesty, *M. Am. Soc. C.E., Consulting Engineer, Waddell and Hardesty,* New York, N.Y., and Alfred Hedefine, *Assoc. M. Am. Soc. C.E., Associate Engineer, Waddell and Hardesty,* New York, N.Y., for Paper No. 2124, "Superstructure of Theme Building of New York World's Fair."

The James Laurie Prize to W. Watters Pagon, *M. Am. Soc. C.E., Consulting Engineer,* Baltimore, Md., for Paper No. 2122, "Transatlantic Seaplane Base, Baltimore, Maryland."

The Arthur M. Wellington Prize to William J. Wilgus, *Hon. M. Am. Soc. C.E.,* Ascutney, Vt., for Paper No. 2119, "The Grand Central Terminal in Perspective."

The Collingwood Prize for Juniors to John F. Curtin, *Jun. Am. Soc. C.E., Senior Civil Engineer, The Texas Company,* New York, N.Y., for Paper No. 2104, "Bridge and Tunnel Approaches."

The Rudolph Hering Medal to Robert T. Regester, *M. Am. Soc. C.E., Consulting Engineer,* Baltimore, Md., for Paper No. 2102, "Problems and Trends in Activated Sludge Practice."

The Construction Engineering Prize to Rear-Admiral Frederic R. Harris, *C.E.C., U.S. Navy (Retired), M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y., for paper appearing in June 1942 issue of Civil Engineering entitled "Evolution of Tremie-Placed Concrete Dry Docks."

The Daniel W. Mead Prize to Alfred C. Ingersoll, *Jun. Am. Soc. C.E.; Research Engineer, The Linde Air Products Company,* Tonawanda, N.Y., for the best paper submitted by a Student on "Ethical Standards and How Best They Can Be Developed."

11:00 **Conferring of Honorary Memberships**

Alonzo J. Hammond, *Hon. M. Am. Soc. C.E., Consulting Engineer,* Chicago, Ill.; *Member, Construction Contract Board, Corps of Engineers,* U.S. Army, Washington, D.C.

Mr. Hammond will be presented to the President by Richard E. Dougherty, *M. Am. Soc. C.E., Vice-President, Improvements and Development, New York Central System,* New York, N.Y.

Lawrence M. Lawson, *Hon. M. Am. Soc. C.E., U.S. Commissioner, International Boundary Commission, United States and Mexico,* El Paso, Tex.

Mr. Lawson will be presented to the President by Samuel B. Morris, *M. Am. Soc. C.E., Dean, School of Engineering, Stanford University,* Calif.

Rear-Admiral Ben Moreell, *C.E.C., U.S. Navy, Hon. M. Am. Soc., C.E., Chief, Bureau of Yards and Docks and Chief of Civil Engineers,* U.S. Navy, Washington, D.C.

Admiral Moreell will be presented to the President by Rear-Admiral Frederic R. Harris, *C.E.C., U.S. Navy (Retired), M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

Lt. Gen. Brehon B. Somervell, *Corps of Engineers, U.S. Army, Hon. M. Am. Soc. C.E., Commanding General, Services of Supply,* War Department, Washington, D.C.

General Somervell will be presented to the President by Arthur S. Tuttle, *Past-President, Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

Sherman M. Woodward, *Hon. M. Am. Soc. C.E., Consultant and Chief Water Control Planning Engineer, Tennessee Valley Authority,* Knoxville, Tenn.

Mr. Woodward will be presented to the President by Daniel W. Mead, *Past-President, Am. Soc. C.E., Professor Emeritus, Hydraulic and Sanitary Engineering, University of Wisconsin; Consulting Engineer,* Madison, Wis.

11:30 **New Business**

Report of Tellers on Canvass of Ballot for Officers

Introduction of President-Elect and New Officers

12:30 **Members' Luncheon**

Fifth Floor, Engineering Societies Building. Tickets $1.25 each.

12:30 **Student Luncheon**

The Town Hall Club, 123 West 43d Street, New York, N.Y. Tickets $1.25 each for members; 60 cents each for Students.

WEDNESDAY—January 20, 1943—Afternoon

THE ALCAN HIGHWAY

(Canadian-Alaskan Military Highway)

Auditorium—2:00 p.m.

Prof. Charles M. Spofford, *Vice-President, Am. Soc. C.E.,* Chairman of the Meeting

Maj. Gen. Thomas M. Robins, *Corps of Engineers, U.S. Army, M. Am. Soc. C.E., Acting Chief of Engineers, War Department,* Washington, D.C., Presiding

Introductory remarks

2:00 Charles M. Spofford, *Vice-President, Am. Soc. C.E., Hayward Professor of Civil Engineering (Emeritus), Massachusetts Institute of Technology,* Cambridge, Mass.; *Consulting Engineer, Fay, Spofford and Thorndike,* Boston, Mass.

2:05 Maj. Gen. Thomas M. Robins, *Corps of Engineers, U.S. Army, M. Am. Soc. C.E., Acting Chief of Engineers, War Department,* Washington, D.C.

2:15 **History, Organization and Progress of the Alcan Military Highway Project**
Brig. Gen. C. L. Sturdevant, *Assistant Chief of Engineers, War Department,* Washington, D.C.

2:45 **Discussion**

2:55 **The Construction Activities of the Public Roads Administration and their Contractors in Cooperation with the War Department Corps of Engineers on the Canadian-Alaskan Military Highway**
Joint paper by Thomas H. MacDonald, *Commissioner, U.S. Public Roads Administration,* Washington, D.C., and Joseph S. Bright, *M. Am. Soc. C.E., Care, U.S. Public Roads Administration,* Seattle, Wash.; *District Engineer in Charge of the Project.*
To be presented by Thomas H. MacDonald.

3:25 **Discussion**

3:35 **Technique Used in Locating the Alcan Highway**
Col. Albert L. Lane, *Corps of Engineers, U.S. Army, Assoc. M. Am. Soc. C.E.,* Washington, D.C.

4:05 **Discussion**

4:15 **Design Problems Presented by Soil and Climatic Conditions on the Canadian-Alaskan Military Highway**
A. C. Clark, *Assistant Construction Engineer, U.S. Public Roads Administration, Washington, D.C.*

U.S. Army Engineer Photo

Heavy Work on the Alcan Highway

4:45 **Discussion**

5:00 **Closing remarks**
Maj. Gen. Thomas M. Robins
Prof. Charles M. Spofford

5:15 **Adjournment**

Student Chapter Conference

WEDNESDAY—January 20, 1943—Afternoon

Engineering Societies Building

Program sponsored by the Society's Committee on Student Chapters, E. M. Hastings, *Chairman; Metropolitan Section Committee on Student Chapters,* R. E. Bakenhus, *Chairman; Conference of Metropolitan Student Chapters,* S. Ralph Angell, *Chairman*

9:00 **Registration in the Lobby**

10:00 **General Session in the Auditorium**
Students will join members of the Society.
Award of prizes, including presentation of the Daniel W. Mead Prize to Alfred C. Ingersoll, *Jun. Am. Soc. C.E., Research Engineer, The Linde Air Products Company,* Tonawanda, N.Y.; *Past-President, University of Wisconsin Student Chapter, Am. Soc. C.E.,* for the best paper submitted by a Student on "Ethical Standards and How Best They Can Be Developed."

12:30 **Student Luncheon**
The Town Hall Club, 123 West 43d St., New York, N. Y.
Toastmaster: C. L. Eckel, *M. Am. Soc. C.E., Professor, Civil Engineering and Head, Civil Engineering Department, University of Colorado,* Boulder, Colo.; *Member, Society's Committee on Student Chapters.*

Welcome to New York
R. E. Bakenhus, *M. Am. Soc. C.E., Rear-Admiral, C.E.C., U.S. Navy (Retired), Consulting Engineer,* N.Y.C.

One minute responses from each Student Chapter represented

Special tickets for members of Student Chapters, 60 cents each. Tickets for members of the Society, $1.25 each.

Room 501A and 501B

2:30 **Welcome from Metropolitan Conference**
S. Ralph Angell, *Chairman, Conference of Metropolitan Student Chapters,* Presiding.

2:35 **Student Chapter Activities**
E. M. Hastings, *Chairman, Society's Committee on Student Chapters.*

2:40 **The Effect of the War on Engineering Students**
E. B. Black, *Retiring President of the Society and Consulting Engineer, Black and Veatch,* Kansas City, Mo.

3:00 **Design and Prefabrication of Timber Trusses**
Verne L. Ketchum, *M. Am. Soc. C.E., Chief Engineer, Timber Structures, Inc.,* Portland, Ore.

3:45 **Discussion**

4:00 **Introduction of Student Chapters and members attending**

4:15 **Industrial Camouflage**
William A. Rose, *Assoc. M. Am. Soc. C. E., Assistant Professor, Structural Engineering, New York University,* New York, N.Y.

5:00 **Discussion**

5:15 **Adjournment**

Students will be welcome to join members of the Society at Technical Division sessions of their choice all day Thursday and at the Dinner-Smoker to be held at the Biltmore Hotel on Thursday night. Tickets for the Dinner-Smoker are $2.00 each.

Sessions of Technical Divisions All Day Thursday

THURSDAY—January 21, 1943—Morning

CITY PLANNING DIVISION

Room 501A

C. A. FARWELL, *Member, Executive Committee,* PRESIDING

9:30 Introductory remarks

C. A. FARWELL, *M. Am. Soc. C.E., Consulting Engineer, Fay, Spofford and Thorndike,* Boston, Mass.

THE ECONOMIC EFFECT OF HOUSING UPON CITY PLANS

9:40 The War Housing Program

JACOB L. CRANE, JR., *M. Am. Soc. C.E., Director of Urban Studies, National Housing Agency,* Washington, D.C.

10:20 Discussion

10:35 A Postwar Housing Program

HARLAND BARTHOLOMEW, *M. Am. Soc. C.E., City Planner,* St. Louis, Mo.

11:15 Discussion

11:30 Adjournment

SANITARY ENGINEERING DIVISION

Room 503

LINN H. ENSLOW, *Chairman, Executive Committee,* PRESIDING

9:30 Introductory remarks

LINN H. ENSLOW, *Assoc. M. Am. Soc. C.E., Editor, "Water Works and Sewerage,"* New York, N.Y.

9:35 Waste Disposal in Army Cantonments

J. L. VINCENZ, *Repair and Utilities, U.S. War Department,* Washington, D.C.

10:15 Discussion

10:25 Performance of Final Settling Tanks of Novel Design

RICHARD H. GOULD, *M. Am. Soc. C.E., Director, Division of Engineering, Department of Public Works,* New York, N.Y.

10:55 Discussion

11:05 Report of Committee on Water Supply Engineering

THOMAS H. WIGGIN, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

11:45 Discussion

12:00 Adjournment

SOIL MECHANICS AND FOUNDATIONS DIVISION

Room 501B

JOEL D. JUSTIN, *Chairman, Executive Committee,* PRESIDING

9:30 Introductory remarks

JOEL D. JUSTIN, *M. Am. Soc. C.E., Consulting Engineer,* Philadelphia, Pa.

9:35 Proposed Soil Classification for Airfield Projects

ARTHUR CASAGRANDE, *M. Am. Soc. C.E., Associate Professor, Civil Engineering, Graduate School of Engineering, Harvard University,* Cambridge, Mass.

Discussion by

10:10 KARL TERZAGHI, *M. Am. Soc. C.E., Lecturer, Harvard University,* Cambridge, Mass.

10:20 CHESTER A. HOGENTOGLER, *Assoc. M. Am. Soc. C.E., Senior Highway Engineer, U.S. Bureau of Public Roads,* Washington, D.C.

10:30 COL. JAMES H. STRATTON, *Corps of Engineers, U.S. Army, Assoc. M. Am. Soc. C.E., Chief, Engineering Branch, Construction Division, Office, Chief of Engineers, War Department,* Washington, D.C.

10:40 BERNARD E. GRAY, *Chief Engineer, The Asphalt Institute,* New York, N.Y.

10:50 Design of Drainage Facilities for Airfields

GAIL A. HATHAWAY, *M. Am. Soc. C.E., Principal Hydraulic Engineer, Office, Chief of Engineers, War Department,* Washington, D.C.

Discussion by

11:20 CAPT. H. MITTENDORF, *Corps of Engineers, Chief, Drainage, Water Supply and Sanitation Section, Office of Division Engineer, South Atlantic Division,* Atlanta, Ga.

11:30 RAYMOND L. IRWIN, *Assoc. M. Am. Soc. C.E., Associate Hydraulic Engineer, Office of Division Engineer, Ohio River Division,* Columbus, Ohio.

11:40 General discussion from the floor

12:05 Adjournment

CONSTRUCTION DIVISION

Room 502

HARRY O. LOCHER, *Chairman, Executive Committee,* PRESIDING

9:30 Introductory remarks

HARRY O. LOCHER, *M. Am. Soc. C.E., Secretary-Treasurer, The National Association of River and Harbor Contractors,* New York, N.Y.

9:40 Durability Studies of Cement and Concrete

CHARLES E. WUERPEL, *Senior Engineer, Corps of Engineers, U.S. Army, North Atlantic Division,* Mount Vernon, N.Y.

10:20 Discussion

10:35 Modern Shipyards Designed for Assembly-Line Methods

ADOLPH J. ACKERMAN, *M. Am. Soc. C.E., Director of Engineering and Director of Plant Expansion, Dravo Corporation,* Pittsburgh, Pa.

11:15 Discussion

11:30 Adjournment

ARE YOU ACQUAINTED AT HEADQUARTERS?

It has been found that many members come to New York at one time or another and yet have never visited Headquarters. During the Annual Meeting, you are cordially invited to get acquainted with the Headquarters of your Society. Special guide service can be provided at certain hours and we are sure you would be interested in visiting the Engineering Societies Building Library on the 13th Floor. In addition to extending a cordial welcome, we also call your attention to the services rendered by the Society's staff at Headquarters to visiting members, which were outlined on Page 404 of the July 1942 issue of CIVIL ENGINEERING.

THURSDAY—January 21, 1943—Afternoon

HIGHWAY DIVISION

Room 501A

C. D. Curtiss, *Secretary, Executive Committee,* Presiding

2:00 Introductory remarks

C. D. Curtiss, *M. Am. Soc. C.E., Chief, Division of Control, Public Roads Administration, Federal Works Agency,* Washington, D.C.

2:10 Soil-Aggregate Mixtures for Stability of Roads and Runways

Roy W. Crum, *M. Am. Soc. C.E., Director, Highway Research Board, Division of Engineering and Industrial Research, National Research Council,* Washington, D.C.

2:50 Discussion

3:05 Trends and Problems in Highway Engineering Education

Gibb Gilchrist, *M. Am. Soc. C.E., Dean of Engineering, Agricultural and Mechanical College of Texas,* College Station, Tex.

3:45 Discussion

4:00 Adjournment

SANITARY ENGINEERING DIVISION

Room 503

Linn H. Enslow, *Chairman, Executive Committee,* Presiding

2:00 Introductory remarks

Linn H. Enslow, *Assoc. M. Am. Soc. C.E., Editor, "Water Works and Sewerage,"* New York, N.Y.

2:05 Calculating Coagulant Requirements in Sludge Conditioning

A. L. Genter, *M. Am. Soc. C.E., Consulting Engineer,* Baltimore, Md.

2:40 Discussion by

Paul D. McNamee, *Chief Chemist, District of Columbia Sewage Treatment Plant, Blue Plains, D.C.*

SYMPOSIUM ON THE PRACTICE AND ECONOMY OF SLUDGE CONCENTRATION

3:00 R. F. Goudey, *M. Am. Soc. C.E., Sanitary Engineer, Bureau of Water Works and Supply,* Los Angeles, Calif.

3:10 C. E. Keefer, *M. Am. Soc. C.E., Associate Engineer, Bureau of Sewers,* Baltimore, Md.

3:30 Willem Rudolfs, *M. Am. Soc. C.E., Chief, Department of Water and Sewage Research, New Jersey Agricultural Experiment Station,* New Brunswick, N.J.

3:50 W. Donaldson, *M. Am. Soc. C.E., Chief, Bureau of Sewage Disposal Design, Department of Public Works,* New York, N.Y.

4:10 Robert T. Regester, *M. Am. Soc. C.E., Consulting Engineer,* Baltimore, Md.

4:30 E. T. Killam, *M. Am. Soc. C.E., Hydraulic and Sanitary Engineer,* New York, N.Y.

4:50 Discussion

5:00 Adjournment

SOIL MECHANICS AND FOUNDATIONS DIVISION

Room 501B

Joel D. Justin, *Chairman, Executive Committee,* Presiding

2:00 Introductory remarks

Joel D. Justin, *M. Am. Soc. C.E., Consulting Engineer,* Philadelphia, Pa.

2:05 Reports of Committees Summarized by

Hamilton Gray, *Jun. Am. Soc. C.E., Assistant Professor, Civil Engineering, New York University,* New York, N.Y.; *Secretary, Executive Committee, Soil Mechanics and Foundations Division, Am. Soc. C.E.*

2:25 Piston Samplers and Their Use in Various Types of Soils

M. Juul Hvorslev, *Assoc. M. Am. Soc. C.E., Graduate School of Engineering, Harvard University,* Cambridge, Mass.

Discussion by

2:55 H. A. Mohr, *M. Am. Soc. C.E., District Manager, Raymond Concrete Pile Company,* Boston, Mass.

3:05 E. R. Fadum, *Jun. Am. Soc. C.E., Instructor in Civil Engineering, Graduate School of Engineering, Harvard University,* Cambridge, Mass.

3:15 Testing Methods for Prediction of Bearing Values

Philip C. Rutledge, *Assoc. M. Am. Soc. C.E., Professor, Soil Mechanics, School of Civil Engineering, Purdue University,* West Lafayette, Ind.; *Chairman, Committee on Sampling and Testing, Purdue University.*

Discussion by

3:45 Thomas E. Stanton, *Vice-President, Am. Soc. C.E., Materials and Research Engineer, State Division of Highways,* Sacramento, Calif.

3:55 O. J. Porter, *M. Am. Soc. C.E., Senior Physical Testing Engineer, Materials and Research Department, State Division of Highways,* Sacramento, Calif.

4:05 George L. Freeman, *M. Am. Soc. C.E., Consulting Engineer, Moran, Proctor, Freeman and Mueser,* New York, N.Y.

4:15 General discussion from the floor

4:40 Adjournment

STRUCTURAL DIVISION

Room 502

Charles A. Ellis, *Member, Executive Committee,* Presiding

Introductory remarks

2:00 Charles A. Ellis, *M. Am. Soc. C.E., Professor, Structural Engineering, Purdue University,* West Lafayette, Ind.

2:05 Eugene L. Macdonald, *M. Am. Soc. C.E., Consulting Engineer, Parsons, Klapp, Brinckerhoff and Douglas,* New York, N.Y.

2:15 Recent Developments in Reinforced Concrete Structures

A. J. Boase, *M. Am. Soc. C.E., Manager, Structural and Technical Bureau, Portland Cement Association,* Chicago, Ill.

Discussion by

2:55 George A. Maney, *M. Am. Soc. C.E., Professor, Structural Engineering, and Administrative Chairman, School of Engineering, Northwestern University,* Evanston, Ill.

3:05 Joseph Di Stasio, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

3:15 Recent Developments in Timber Structures

Howard J. Hansen, *Assoc. M. Am. Soc. C.E., Associate Professor, Civil Engineering, Agricultural and Mechanical College,* College Station, Tex.

Discussion by

3:55 Verne Ketchum, *M. Am. Soc. C.E., Chief Engineer, Timber Structures, Inc.,* Portland, Ore.

4:05 Ralph H. Mann, *M. Am. Soc. C.E., Field Engineer, Service Bureau, American Wood Preservers' Association,* New York, N.Y.

4:15 General discussion

4:30 Adjournment

Dinner, Reception, and Dance

WEDNESDAY—January 20, 1943—Evening

Grand Ballroom, Hotel Waldorf-Astoria

Committee: Homer R. Seely, *Chairman;* Alfred Hedefine, *Vice-Chairman;* Joseph O. May

7:00 Assembly

7:45 Dinner

9:30 Reception to the President and Honorary Members

10:00 Dancing

This function will be held in the Grand Ballroom of the Hotel Waldorf-Astoria, Park Avenue and 50th Street, New York, N.Y.

Dinner will be served promptly at 7:45 p.m.

Arrangements have been made for tables seating ten persons, and members may underwrite complete tables. Orders to underwrite a table must be accompanied by check in full and a list of guests.

Tickets will be $6.00 each. Tickets for Juniors, for the dance only, will be $2.00 per couple.

The seating list for the Dinner-Dance will close at 5:00 p.m., Tuesday, January 19, 1943. Those who purchase tickets after that hour will be assigned to tables in the order of purchase. Tickets will be on sale at Society Headquarters until 5:00 p.m., Wednesday, January 20, 1943.

College Reunions Throughout the Week

THURSDAY—January 21, 1943

Brown Engineering Association

There will be a luncheon meeting of the Brown Engineering Association during the Am. Soc. C.E. Annual Meeting. The luncheon will be held in the Hotel Bristol, 129 West 48th Street, New York, N.Y., on Thursday, January 21, 1943, at 12:30 p.m. Everyone invited. Cost 60 cents per cover. If you plan to attend, will you kindly notify Mr. Sydney Wilmot, 33 West 39th Street, New York, N.Y. Telephone Pennsylvania 6-9220.

Luncheon of Chi Epsilon Honorary Civil Engineering Fraternity

For the ninth consecutive year, members of Chi Epsilon, their families, and their friends, will meet for a very informal luncheon at the Midston House, 22 East 38th Street, New York, N.Y., on Thursday, January 21, 1943, at 1:15 p.m. The charge will be $1.25 per person. Make reservations through R. I. Land, 100 East 42d Street, New York, N.Y. (Ashland 4-3300) or Room 1610, Engineering Societies Building.

Luncheon of M.I.T. Engineers

All M.I.T. alumni are invited to a luncheon at the Technology Club of New York, 24 East 39th Street, New York, N.Y., on Thursday, January 21, 1943, at 12:30 p.m. Please notify the Technology Club (Caledonia 5-7424) as to attendance.

Rutgers University Annual Dinner

Rutgers University Civil Engineering Alumni will meet for their annual dinner at 6:30 p.m., on Thursday, January 21, 1943, at the Am. Soc. C. E. Dinner-Smoker at the Biltmore Hotel, Madison Avenue and 43d Street, New York, N.Y. (The full notice of the Dinner-Smoker is given elsewhere in this program.) Private dining rooms located on the same floor on which the Dinner-Smoker is to be held will be reserved for the college reunions. Dinner-Smoker tickets are $2.00 for members and $3.00 for non-members of the Society. Members of the Society should order tickets from Society Headquarters, sending their name to C. H. Gronquist, Room 1104, 117 Liberty Street, New York, N.Y., if they wish to sit with the Rutgers group. Non-members should order tickets from Mr. Gronquist.

Syracuse University Alumni Dinner

Graduates and former students of the College of Applied Science, Syracuse University, will hold an informal dinner at Rutley's, 1440 Broadway, New York, N.Y., at 6:30 p.m., on Thursday, January 21, 1943. Reservations at $1.50 per plate may be secured by writing Elliott D. Lynde, 51 Surrey Lane, Tenafly, N.J.

University of Illinois Engineers' Dinner

The University of Illinois civil engineering alumni and their friends will meet for their fifteenth annual informal dinner at 6:30 p.m., on Thursday, January 21, 1943, at the Am. Soc. C.E. Dinner-Smoker at the Biltmore Hotel, Madison Avenue and 43d Street, New York, N.Y. (The full notice of the Dinner-Smoker is given elsewhere in this program.) Private dining rooms located on the same floor on which the Dinner-Smoker is to be held will be reserved for the college reunions. Dinner-Smoker tickets are $2.00 for members and $3.00 for non-members of the Society. To simplify seating arrangements, all tickets should be ordered from Society Headquarters and if you wish to sit with the Illinois group, send your name either to Maurice N. Quade, 41 East 42d Street, New York, N.Y. (Vanderbilt 6-3790) or to Room 1610, Engineering Societies Building.

FRIDAY—January 22, 1943

Dinner of Columbia Engineers

The twenty-second annual civil engineering dinner of the graduates of the School of Engineering of Columbia University will be held at the Columbia University Club, 4 West 43d Street, New York, N.Y., at 6:15 p.m., Friday, January 22, 1943. Prof. W. J. Krefeld will describe briefly a special research on "Impact Stresses." The guest of honor will be Frederick Coykendall, C.E. '97, Chairman of the Board of Trustees. The usual charge of $2.00 will be collected at the dinner.

Dinner of Cornell Society of Engineers

A buffet dinner of the Cornell Society of Engineers will be held on Friday, January 22, 1943, at 6:30 p.m., at the Cornell Club, 107 East 48th Street, New York, N.Y. Speakers will be announced later. Dinner $1.35. For further information, call Paul Reyneau, Secretary, Cornell Club (Plaza 5-7210). All Cornellians are cordially invited.

Thayer Society of Engineers of Dartmouth College

The annual meeting and dinner of the Thayer Society of Engineers of Dartmouth College will be held at the Dartmouth College Club, 37 East 39th Street, New York, N.Y., on Friday, January 22, 1943, at 6:30 p.m.

SATURDAY—January 23, 1943

Clarkson College Alumni Association

The annual meeting and dinner of the Clarkson College Alumni Association will be held at the Building Trades Employers Association Club, 26th Floor, 2 Park Avenue, New York, N.Y., on Saturday, January 23, 1943, at 6:30 p.m.

There will also be an informal luncheon and an afternoon meeting on the same day and in the same place.

New York University Civil Engineering Alumni Dinner

The annual dinner of the New York University Civil Engineering Alumni will be postponed until February or March 1943.

Dinner-Smoker

THURSDAY—January 21, 1943—Evening

Banquet Room, Hotel Biltmore

Committee: RALPH H. MANN, *Chairman;* L. S. WATERBURY, *Vice-Chairman;* JAMES H. GRIFFIN

6:30 Dinner

8:30 Entertainment

The annual Smoker will again be held this year on a Thursday night, in the Banquet Room of the Hotel Biltmore, 43d Street and Madison Avenue, New York, N.Y. This year, the program will vary somewhat from former years in that dinner will be served at 6:30 p.m. At 8:00 p.m., tables will be removed from the Banquet Room for an hour of entertainment to begin promptly at 8:30 p.m. After the entertainment, members and guests will be welcome to stay around as late as they wish to visit with old friends and make new acquaintances.

Another innovation is that college reunion dinners ordinarily planned for Thursday night will be held in small private dining rooms at the Biltmore adjacent to the Banquet Room in order that the entire group may be together for the entertainment following dinner.

Members' and Students' Tickets, $2.00.

Guest Tickets, $3.00.

Hotel Accommodations and General Announcements

Hotel Accommodations

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least two weeks in advance of the Annual Meeting.

Hotel Rates

Hotels	Without Private Bath		With Private Bath	
	Single Room	Double Room	Single Room	Double Room
Waldorf-Astoria	......	......	$6.00 up	$9.00 up
Astor	......	......	3.50 up	5.00 up
Barclay	......	......	5.00 up	8.00 up
Biltmore	......	......	5.00 up	7.00 up
Chatham	......	......	5.00 up	7.00 up
Claridge	$2.00 up	$3.00 up	2.50 up	3.50 up
Commodore	......	......	3.50 up	5.50 up
Edison	......	......	2.50 up	4.00 up
Governor Clinton	......	......	3.30 up	4.40 up
Lexington	......	......	4.00 up	6.00 up
McAlpin	2.20 up	3.85 up	3.30 up	4.95 up
Murray Hill	2.00 up	3.00 up	2.50 up	4.00 up
New Yorker	......	......	3.85 up	5.50 up
Park Central	......	......	4.00 up	6.00 up
Pennsylvania	......	......	3.85 up	5.50 up
Pierre	......	......	6.00 up	8.00 up
Plaza	......	......	6.00 up	8.00 up
Roosevelt	......	......	4.50 up	6.50 up
Savoy-Plaza	......	......	6.00 up	8.00 up
Taft	2.00 up	3.00 up	2.50 up	3.50 up
Vanderbilt	......	......	3.00 up	5.00 up
Woodward	......	......	2.50 up	3.50 up

Note: The Waldorf-Astoria, at which the reception, dinner, and dance will be held on Wednesday evening, will care for reservations to the extent of its capacity.

Facilities of the Engineers' Club

Members may use the dining facilities of the Engineers' Club, 32 West 40th Street, New York City, on a cash basis. Guest cards for this purpose may be obtained at the Registration Desk. The Club will also be able to accommodate a limited number of members, the price of rooms ranging from $2.50 upward. Requests for reservations should be made in advance and addressed to Society Headquarters.

Information Desk

An Information Desk is provided in the Reading Room of the Society on the 15th Floor of the Engineering Societies Building to assist visiting members in obtaining hotel reservations and theater tickets, and in securing any desired information.

Your New York Address

At the Registration Desk a card file of those in attendance will be maintained, with information as to members' hotel addresses in New York. Members are requested to keep Society Headquarters informed as far as possible of their New York addresses so as to expedite the delivery of telegrams, telephone messages, and mail.

Order Tickets in Advance

Members who order tickets in advance will assist the Annual Meeting Committee greatly by giving advance information to guide it in concluding arrangements. Ticket order blanks have been mailed to each member with the condensed program. No cancellation of tickets can be made after noon of Wednesday January 20, 1943.

A Planning Conference on Sanitation for the Post-War Period

A Planning Conference on Sanitation for the Post-War Period will be held on Tuesday, January 19, 1943, at the Engineers' Club, 32 West 40th Street, New York, N.Y. Many national leaders in related fields have been invited to be present and participate in a round-table discussion of the subject at morning and afternoon sessions to which observers will be welcome.

Regional Meeting Committee

This program has been prepared under the direction of the Committee on Regional Meetings, C. M. SPOFFORD, *Vice-President, Am. Soc. C.E., Chairman;* and C. M. BLAIR, VAN TUYL BOUGHTON, GEORGE W. BURPEE, JOHN W. COWPER, E. P. GOODRICH, and LAZARUS WHITE, *Directors, Am. Soc. C.E.*

Committee on Local Arrangements for the Annual Meeting

E. L. MACDONALD, *Chairman*
HOMER R. SEELY, *Vice-Chairman*

DAVID G. BAILLIE, JR.
E. WARREN BOWDEN
JOHN M. BUCKLEY
JAMES H. GRIFFIN
ALFRED HEDEFINE
RALPH H. MANN
JOSEPH O. MAY
SIDNEY M. SHAPIRO
ELMER K. TIMBY
L. S. WATERBURY

Junior Members

EDGAR W. BISHOP
ARCHIE N. CARTER
SHERMAN GLASS
EDWARD E. LUSTBADER
DON P. REYNOLDS
SIDNEY WENIGER

Please call on the Committee on Local Arrangements for the Annual Meeting, or on the Secretary's Office, for any service desired.

Events for the Ladies Curtailed

For more years than most of us can remember, the wives of many members have looked forward to Annual Meetings of the Society with as much anticipation and pleasure as the members themselves. Not only has it given them the opportunity to see New York and its innumerable points of interest, but also to form warm and lasting friendships with wives of other engineers.

In view of the number of ladies usually present at the Annual Meetings, some special activities have always been planned for them. Even last year, when we had just entered the war, there were special events for them although not so elaborate as in previous years. This year, the Annual Meeting will reflect the definite pinch of war. The exigencies of present conditions have handicapped all meeting arrangements—the program for the men, that for the ladies, and that of joint social events. Ladies should particularly note the annual dinner, reception, and dance to be held on Wednesday, as the success of this event depends on their presence.

It is hoped that a large number of ladies will accompany their husbands, to take in not only the regular meeting events but also to enjoy those advantages that New York City offers in such abundance. Theaters, shops, museums, and music centers are only a few of the many attractions. Ladies are more welcome than ever.

Meeting of the New York State Sewage Works Association

Hotel McAlpin, Broadway and 34th St., New York, N. Y.

All Members of the Sanitary Engineering Division of the American Society of Civil Engineers Are Invited

FRIDAY—January 22, 1943—All Day

Ballroom

8:30 Registration

Winter Garden

10:00 Annual Business Meeting

11:15 A Sewerage Project Designed Without Critical Materials

PAUL E. LANGDON, *M. Am. Soc. C.E., Greeley and Hansen,* Chicago, Ill.

Discussion opened by

A. M. RAWN, *M. Am. Soc. C.E., Chief Engineer and General Manager, Los Angeles County Sanitation Districts,* Los Angeles, Calif.

Ballroom

12:15 Joint Luncheon with Sanitary Engineering Division Am. Soc. C.E.

Presentation of Awards

FORUM: THE INFLUENCE OF THE WAR ON SANITARY ENGINEERING

Leader: LINN H. ENSLOW, *Chairman, Sanitary Engineering Division, Am. Soc. C.E.*

Participants:

CHARLES A. HOLMQUIST, *Director, Sanitary Engineering,* Albany, N.Y. (*State Engineer*)

CHARLES G. HYDE, *M. Am. Soc. C.E., Professor, Sanitary Engineering, University of California,* Berkeley, Calif. (*Educator*)

WILLIAM M. PIATT, *M. Am. Soc. C.E., Consulting Engineer,* Durham, N.C. (*Designer*)

GEORGE J. SCHROEPFER, *Assoc. M. Am. Soc. C.E., Chief Engineer and Superintendent, Minneapolis–St. Paul Sanitary District,* St. Paul, Minn. (*Operator*)

Recess

3:15 Vacuum Flotation of Sewage and Industrial Wastes

ANTHONY J. FISCHER, *Assoc. M. Am. Soc. C.E., Sanitary Development Engineer, Development Department, The Dorr Company, Inc.,* New York, N.Y.

Discussion opened by

HARRY W. GEHM, *Associate, Department of Water and Sewage Research, New Jersey Agricultural Experiment Station,* New Brunswick, N.J.

4:00 Grease Removal by Flotation

CAPT. ROLF ELIASSEN, *Corps of Engineers, U.S. Army, Assoc. M. Am. Soc. C.E., North Atlantic Division, U.S. Army,* New York, N.Y.

H. B. SCHULHOFF, *Assistant Chemist, North Atlantic Division, U.S. Army,* New York, N.Y.

Discussion opened by

W. DONALDSON, *M. Am. Soc. C.E., Director, Bureau of Sewage Disposal, Department of Public Works,* New York, N.Y.

4:45 Overhauling a Methane Gas Holder

C. GEORGE ANDERSEN, *Superintendent, Sewerage and Sewage Treatment,* Rockville Centre, N.Y.

5:15 Adjournment

Ballroom—6:30 p.m.

ANNUAL JOINT DINNER WITH SANITARY ENGINEERING DIVISION, AMERICAN SOCIETY OF CIVIL ENGINEERS

LINN H. ENSLOW, *Chairman, Sanitary Engineering Division, Am. Soc. C.E.,* PRESIDING

WILLIAM J. ORCHARD, MASTER OF CEREMONIES

Comments

EZRA B. WHITMAN, *President-Elect, American Society of Civil Engineers.*

Reminiscences

GEORGE T. SEABURY, *Secretary, American Society of Civil Engineers.*

The Sanitary Engineer in a Postwar World

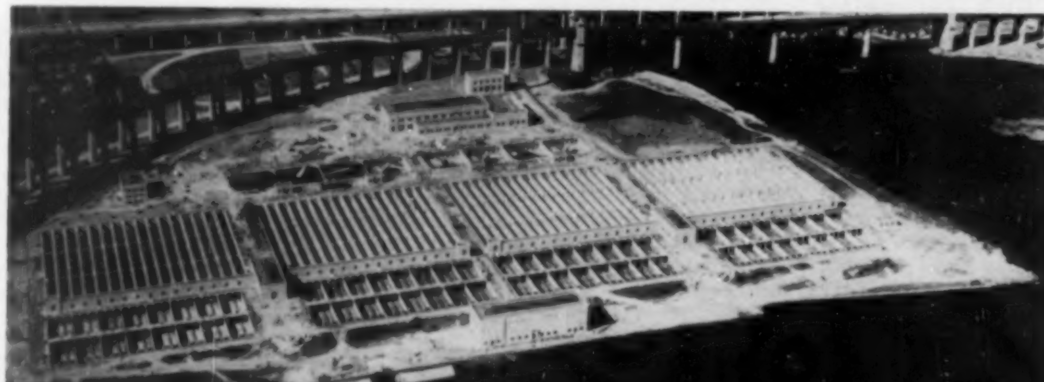
ABEL WOLMAN, *M. Am. Soc. C.E., Professor, Sanitary Engineering, Johns Hopkins University,* Baltimore, Md.; *President, American Water Works Association.*

Entertainment by the "Bill" Orchard Management

Tickets—$3.00 each

Important: Tickets should be purchased at the Registration Desk of the New York State Sewage Works Association in the Ballroom of the Hotel McAlpin before 3:00 p.m. Friday, January 22. Arrangements are difficult in these times and to avoid confusion and possible inability to seat last-minute guests, **Please Buy Your Tickets Before 3:00 p.m.**

Note: On Saturday, January 23, there will be no organized inspection trip largely owing to transportation restrictions.



WARDS ISLAND SEWAGE DISPOSAL PLANT

SOCIETY AFFAIRS

Official and Semi-Official

Society Prizes and Medals to Be Awarded

Eight Members to Receive Recognition at the Annual Meeting for Outstanding Contributions to Society Publications

IN accordance with its usual custom, the Society will present prizes and medals at its Annual Meeting to be held in New York City, January 20–22, 1943. Oldest of these Society awards is the Norman Medal, which was established in 1872 by the late George H. Norman, M. Am. Soc. C. E., for an original paper that is considered an especially important contribution to the profession. Next in point of distinction is the J. James R. Croes Medal, established by the Society in 1912 and named for the first recipient of the Norman Medal.

The late Thomas Fitch Rowland, Hon. M. Am. Soc. C.E., endowed the prize bearing his name in 1884. This award goes to a paper that best describes in detail some accomplished works of construction. For the paper adjudged second in merit to that awarded the Thomas Fitch Rowland Prize, the Society in 1912 established the James Laurie Prize, which was named in honor of the first President.

In 1924 the Sanitary Engineering Division of the Society instituted and endowed the Rudolph Hering Medal, which goes to the author of the paper considered the most valuable contribution to the advancement of the sanitary branch of the profession.

In 1921 the Arthur M. Wellington Prize for the best paper on some phase of transportation was established and endowed by the *Engineering News-Record*. Although the recipient of this prize need not be a member of the Society, its award rests with the Society. The Collingwood Prize for Juniors was established in 1894 by the late Francis Collingwood, M. Am. Soc. C.E., on his retirement as Secretary of the Society. To be eligible for this award papers must describe an engineering work or record an important investigation with which the author has been connected. Excellence of style is another governing factor in the selection of the paper receiving this prize.

Biographical sketches of the recipients of these prizes and medals follow.

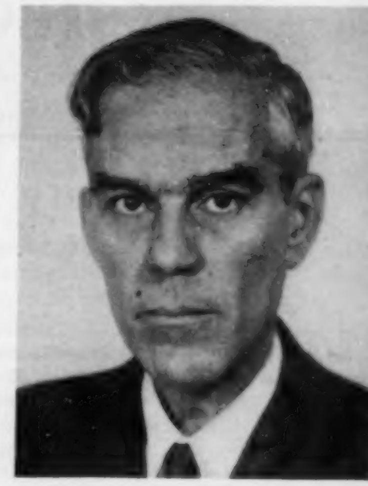
KARL TERZAGHI, M. Am. Soc. C.E., was born in Prague, Czechoslovakia, on October 2, 1883, and graduated from the Technische Hochschule in Graz, Austria, in 1904. From 1905 to 1914 he worked in various capacities, mostly as superintendent of construction, on jobs in Austria, the Balkans, northern Russia, and the western part of the United States, and from 1914 to 1916 served as a first lieutenant in the air corps of the Austrian Army. In the latter year he became a professor at the Imperial Engineering School in Istanbul, Turkey, remaining until 1918 when he exchanged his position for a similar one at Robert College (an American institution) in Istanbul. He was at Robert College until 1925, supplementing his practical experience with foundations by extensive experimental research, the results of which were published in 1925 in a book entitled *Erdbaumechanik*. From 1925 to 1929 Dr. Terzaghi continued his teaching activities at Massachusetts Institute of Technology. During this period he served in a consulting capacity on various dam, foundation, and subway projects. In 1929 he accepted a professorship at the Technische Hochschule in Vienna and remained there until 1938. During these years he was a consultant on the hydroelectric power development, Swir III, in northern Russia; on various irrigation projects in Central Asia and Transcaucasia; on the construction of rockfill dams in Algiers; and on numerous other structures in the Eastern hemisphere. In 1938 Dr. Terzaghi returned to the United States, and he now lectures on engineering geology at Harvard University. From 1938 to 1941 he acted as a consultant on soil mechanics in connection with the building of the Chicago subway, and in 1940 was employed by the Dravo Corporation in Pittsburgh on the construction of two drydocks at Newport News, Va. He is the author of a volume on soil mechanics and of numerous professional papers, and co-author of a book on soil mechanics and one on engineering geology. Dr. Terzaghi is a member of the Institution of Civil Engineers (James Forrest Lecturer for 1939) and of the Boston Society of Civil Engineers (Fitz Gerald Medal). He is the recipient of the Norman Medal for the second time, having won it previously in 1930.

CHARLES F. RUFF, M. Am. Soc. C.E., was born in Missoula, Mont., on November 16, 1895. During the first World War he left Lehigh University to enlist in the 103rd Engineer Corps (Pennsylvania National Guard Division) serving in the Army two years as private and corporal. During this period he attended the engineering school of the University of Toulouse, France. He returned to Lehigh University and graduated in 1920, with the C.E. degree. He then joined the staff of Hazen, Whipple and Fuller, consulting engineers, for whom he engaged on the design of various waterworks and supplies. In 1922 and 1923 he was superintendent of the Long Beach (N.Y.) Water Department, and from 1923 to 1928 was again with Hazen, Whipple and Fuller—most of the time in Florida. From 1929 to 1933 Mr. Ruff was associated with Malcolm Pirnie, New York consultant, and during this period was designer of the St. Petersburg (Fla.) water supply. He served for a short time with the construction division of the National Recovery Administration, representing that division in the New York area. In 1936 he prepared the flood section of the National Resources Committee's Report on the Ohio Basin. From 1937 to 1939 he worked with the Flood Control Bureau of Pennsylvania on various flood projects, and from 1939 to 1941 was in the Flood Control Division of the Federal Power Commission. Since then Mr. Ruff has been engaged in water supply work for various war projects.

SHORTRIDGE HARDESTY, M. Am. Soc. C.E., was born in Weston, Mo., on September 13, 1884. After graduating from Drake University at Des Moines, Iowa, in 1905 with the A.B. degree, he attended Rensselaer Polytechnic Institute, receiving the C.E. degree in 1908. He then entered the office of Waddell and Harrington in Kansas City, Mo., continuing with that firm through 1915. He became designing engineer for the firm of Waddell and Son in 1916, and in 1920 came to New York with Dr. Waddell, in active charge of the latter's office. In 1927 he became Dr. Waddell's partner in the firm of Waddell and Hardesty, and since Dr. Waddell's death in 1938 has continued the practice under the same firm name. Mr. Hardesty's notable bridge work includes the Goethals and Outerbridge cantilever bridges for the Port of New York Authority; the Cooper River cantilever bridge at Charleston, S.C.; the Hudson River lift bridges at Albany and Troy (the heaviest vertical-lift spans now in operation); the North and South Grand Island Bridges over the Niagara River; the Rainbow Bridge over the Niagara River at Niagara Falls (the longest fixed-ended arch span); and the Marine Parkway Bridge over Rockaway Inlet (the longest highway vertical-lift span). He also designed the structural frames of the Trylon and Perisphere for the New York World's Fair, and has made extensive studies on long-span cantilever, arch, and suspension bridges, the mechanical and electrical features of movable bridges, and the application of light-weight floors, alloy steels, and structural aluminum to bridge design and construction. He has been chairman of the Executive Committee of the Structural Division of the Society, and is a member of the American Institute of Consulting Engineers and numerous other engineering organizations. He received the Society's Norman Medal in 1941, and an honorary LL.D. from Drake University in 1928. His honors include Sigma Xi, Tau Beta Pi, and Phi Beta Kappa.

1942 PRIZES AND MEDALS AWARDED

KARL TERZAGHI
Norman Medal for Paper, "General Wedge Theory of Earth Pressure"



CHARLES F. RUFF
J. James R. Croes Medal for Paper, "Maximum Probable Floods on Pennsylvania Streams"

W. WATTERS PAGON
James Laurie Prize for Paper, "Translatlantic Seaplane Base, Baltimore, Maryland"

SHORTRIDGE HARDESTY ALFRED HEDEFINE
Thomas Fitch Rowland Prize for Their Paper, "Superstructure of the Theme Building of New York World's Fair"

WILLIAM J. WILGUS
Arthur M. Wellington Prize for Paper, "The Grand Central Terminal in Perspective"

ROBERT T. REGESTER
Rudolph Hering Medal for Paper, "Problems and Trends in Activated Sludge Practice"

JOHN F. CURTIN
Collingwood Prize for Juniors for Paper, "Bridge and Tunnel Approaches"

ALFRED HEDEFINE, Assoc. M. Am. Soc. C.E., was born in Newport News, Va., on March 9, 1906. He was graduated from Rutgers University in 1929 with the degree of B.S. in civil engineering. He then entered the University of Illinois as a research assistant in the Engineering Experiment Station, and in June 1931 was awarded the degree of M.S. in civil engineering for graduate study and research in structural engineering. He received the professional degree of C.E. from the University of Illinois in June 1942, for his work on the Mill Basin Bridge, a double-leaf trunnion bascule. Mr. Hedefine entered the office of Waddell and Hardesty in 1933, and since that time has been engaged in the design of important fixed and movable bridges and other structures, including the structural frame of the Perisphere for the New York World's Fair. He is at present an associate engineer in the firm. He is a member of the Executive Committee of the Society's Structural Division, and is active in the affairs of the Metropolitan Section of the Society. He is a member of Tau Beta Pi and Sigma Xi, and is a registered professional engineer.

W. WATTERS PAGON, M. Am. Soc. C.E., was born in Baltimore, Md., on June 3, 1885. He graduated from Johns Hopkins University in 1905 with the A.B. degree and from Massachusetts Institute of Technology in 1907 with the S.B. degree. After two years of work with the Baltimore Bridge Company, he entered Harvard University, graduating in 1910 with the M.C.E. degree. Following a summer of travel and study in Europe, he entered the employ of J. E. Greiner, Hon. M. Am. Soc. C.E., engaging upon the design and construction of bridges and other structures, and finally became a member of the firm of J. E. Greiner and Company. On January 1, 1917, Mr. Pagon opened his own consulting office in Baltimore. He has continued as a consultant until the present, except during the first World War when he served as captain in the Construction Division of the Army, engaged upon the construction of Camp Meade in Maryland, and the Curtis Bay Ordnance Depot at Baltimore. He has been consultant to numerous industries on plant construction and operating processes, to several power companies on the design of power plants, and to the U.S. Army and Navy on the design of lighter-than-air ships, being awarded a $5,000 prize by the Navy in a competition held in 1928. More recently he served as consulting engineer to Baltimore on the design and construction of the Baltimore Municipal Airport, which includes the transatlantic seaplane base, described in the 1941 TRANSACTIONS of the Society. Mr. Pagon acted as chairman of a committee which drew up and secured the passage of a charter amendment, creating the Commission on City Plan of Baltimore, and has served as a member of the Commission. He also served as a member of a Charter Revision Commission which revised the charter of Baltimore. With Thomas L. Blakemore, he is the author of *Pressure Airships;* and is the author of a series of papers on "Aerodynamics for the Civil Engineers," which appeared in *Engineering News-Record,* and of other papers. He is a past-president of the Engineers' Club of Baltimore; associate fellow of the Institute of the Aeronautic Sciences; and member of the Society of American Military Engineers and of the Newcomen Society.

ROBERT T. REGESTER, M. Am. Soc. C.E., was born in Baltimore, Md., on June 15, 1903, and was graduated from the Johns Hopkins University in 1925, with the B.Eng. degree. After a short period on steel-mill design, he was appointed junior civil engineer in the Bureau of Sewers, City of Baltimore, where he spent two years on enlargements for Back River Sewage Works and the Eastern Avenue Pumping Station. In 1928 he became designing engineer for the City of Columbus, Ohio, on various sewerage projects, and later was promoted to the position of chief designing engineer, in charge of preparing plans and specifications, for the 50-mgd activated sludge plant at Columbus. In 1937 he returned to Baltimore, as associate engineer with the firm of Whitman, Requardt & Smith, and directed design of the 40-mgd activated sludge additions for the city. Also, he was similarly associated with work on sewage plants for the Washington Suburban Sanitary District and several towns In 1939 Mr. Regester established a consulting practice in Baltimore. He has served as expert consultant to the Corps of Engineers, U.S. Army, on pumping problems and hydrological studies relating to the Susquehanna River flood control projects at Wilkes-Barre and Williamsport, Pa., and has advised several firms upon municipal and military sewage problems. He has also designed the water supply and sewerage systems for the U.S. Army at Aberdeen Airfield (Md.). For several years Mr. Regester has served as consulting engineer to the Baltimore County Metropolitan District upon war public works comprising both water and sewerage projects. He is now retained for the Deer Creek water-supply development, which will serve the entire Aberdeen Proving Ground and cantonment. In 1935 he was elected to Tau Beta Pi. He has been president of the Central Ohio Section of the Society and active on several committees of the Sanitary Engineering Division. At present he is chairman of the Committee on Activated Sludge Practice.

WILLIAM J. WILGUS, Hon. M. Am. Soc. C.E., was born in Buffalo, N.Y., on November 20, 1865. There he had his engineering training in the old-fashioned way, as a pupil of an engineer in private practice; long after he was given the honorary degree of D.Eng. by Stevens Institute of Technology and the University of Vermont. In 1885 he went West, spending the next eight years in Minnesota, Iowa, Illinois, and Missouri on the design, location, and construction of railroads. He returned East in 1893 to spend fifteen years with the New York Central and Hudson River Railroad, advancing from assistant engineer to chief engineer and vice-president in directing the rehabilitation, improvement, and expansion of that system, including the electrification of its New York suburban zone and the inception and construction of Grand Central Terminal, in which utilization of air rights was the governing factor. Turning to private practice in 1908, Mr. Wilgus served the federal government and various states, municipalities, and corporations, acting in particular as chairman of the advisory board of engineers on the Detroit River railroad tunnel. For this project he devised the trench-and-tremie method of subaqueous construction there first used. He was also chairman of the board of consulting engineers on the Holland vehicular tunnel in New York and consultant for the Regional Plan of New York and Its Environs. During the first World War he served as a member of the military railway commission to England and France, director of military railways, and deputy director general of transportation. He had the rank of colonel and had been recommended by General Pershing for a promotion just as the Armistice resulted in the nullifying of all promotions then pending. He was awarded the Distinguished Service Medal, the Conspicuous Service Cross (of New York State), and the French decoration of Officer of the Legion of Honor. He is a member of numerous societies and an honorary member of the American Institute of Architects. Mr. Wilgus is the author of *Transporting the A.E.F. in Western Europe, 1917–1919* and *The Railway Interrelations of the United States and Canada,* and of numerous monographs and papers. The latter include "The Detroit River Tunnel," which brought him the Telford Gold Medal of the Institution of Civil Engineers (London), and "The Electrification of the Suburban Zone of the N.Y.C. & H.R.R.R. in the Vicinity of New York City," for which he was awarded the Society's Thomas Fitch Rowland Prize.

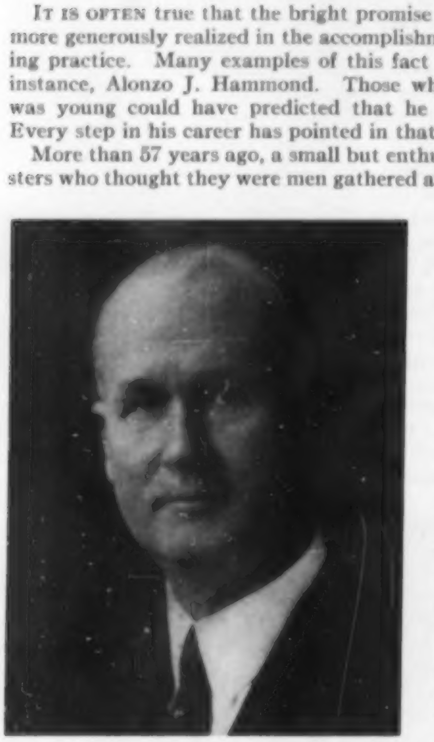
JOHN F. CURTIN, Jun. Am. Soc. C.E., was born in New York City on August 6, 1912. He received his early training at De La Salle Institute, and graduated from New York University in 1937, receiving the degree of bachelor of science in civil engineering. In his junior year he won first prize in a competition conducted by the Metropolitan Section of the Society for the presentation of a student paper. Upon graduation, he received the Metropolitan Section's award to the "most outstanding civil engineering student." From 1932 to 1938, he was a draftsman for the Port of New York Authority, engaged on the planning and design of various projects. In 1937, he was awarded a fellowship at Harvard University to study traffic and highway engineering. From 1938 to 1940 Mr. Curtin was employed as engineering analyst by the Pennsylvania Turnpike Commission on the planning and design of traffic interchanges and tunnel approaches. He held the position of highway engineer-economist with the American Petroleum Institute from 1940 to 1942, and since February of the latter year has been employed by the Texas Company as senior civil engineer on the design of steel and concrete structures at oil refineries. He is the author of several articles and reports on highway development and motor transportation, and has lectured on these subjects at New York University. Mr. Curtin is a member of Iota Alpha fraternity and is a licensed professional engineer in the state of New York.

Five Engineers Awarded Honorary Membership

ALONZO JOHN HAMMOND

IT IS OFTEN true that the bright promise of college days is even more generously realized in the accomplishments of later engineering practice. Many examples of this fact could be adduced, for instance, Alonzo J. Hammond. Those who knew him when he was young could have predicted that he would reach the top. Every step in his career has pointed in that direction.

More than 57 years ago, a small but enthusiastic band of youngsters who thought they were men gathered at the Rose Polytechnic Institute in Terre Haute, Ind. A group of 27 formed the class of 1889, one of the earliest in the many years of usefulness of this institution. Four of that noble band had not then turned sixteen, and of these, two, Messrs. Hammond and Galloway, have achieved Honorary Membership in the Society. This is proof enough that the course was excellent. That it was rigid is evidenced by the fact that just one-third of the original members appeared for graduation in June of 1889.



ALONZO J. HAMMOND

Not long after the class was formed, it became evident that Hammond was the best scholar. He persisted in heading the class, despite attempts to dislodge him from that vulnerable position. When the group lined up to receive degrees, it was Hammond who got the major honor—the Hemmingway Gold Medal awarded to the one whose standing had been highest for the whole course.

Young Hammond was always a dignified youth. This fact is not difficult to believe by those who have known him in later years, any more than is the fact that he was well liked by everyone. Even as a student he had a responsible position on one of the engineering parties making a preliminary survey for a railroad extension in Illinois. He and Galloway were associated on this work, a friendship which has been maintained throughout the years.

There was not much time for the usual college activities, as hard work was the rule. However, it is stated on good authority that on Halloween of their junior year, this small band of devoted students took from its shed the heavy school wagon and elevated it to a prominent position on top of an abandoned coke oven, the wheels pointing to that heaven towards which all good students, and all good engineers too, hope to go. Whether or not Hammond was with the band who started the Institute clock to striking in its tower and thoughtfully locked the door to save the janitor the trouble of stopping the clock, the archives do not state with any assurance. Then there was that incident of the bull calf which was conveyed to the Chapel on the third floor and left there overnight to get religion. The whole college heard the noise when the calf was removed by the janitor next morning.

Not only in college but in general social activities, young Hammond was a leader. It has been unequivocally stated that in those golden days the Terre Haute girls were all beautiful. The future Honorary Member of the Society was known to cast an impartial but interested eye on these young ladies, and history records that they reciprocated his interest.

But it is with Mr. Hammond's professional career that we are mainly concerned. One significant feature of his long practice is that it progressively took him closer and closer to Chicago. He spent almost ten years as city engineer of Frankfort, Ind., and almost another decade even closer, as city engineer of South Bend, Ind. In these positions the usual variety of city engineering fell to his lot—especially the water works and other utilities incident to a rapidly expanding community. He also did architectural and engineering work, notably a number of bridges for the County of St. Joseph, one of which was a plate girder with an approach having a cantilever reinforced-concrete sidewalk, a pioneering design at that time. Other projects were two hydroelectric plants in the St. Joseph River, one of them involving an intricate case of backwater and the eventual establishment of a uniform regimen for the flow. He also served as chief engineer for an interurban railway, locating, designing, and constructing some 63 miles of lines. In addition, he designed the steel frame of a 10-story bank building for South Bend's Union Trust Company, of which he was vice-president.

Starting in 1910, Mr. Hammond began a long and varied experience on important engineering work for the City of Chicago. He performed several months of testing, measurements, and calculation with respect to the 14-ft tunnel being constructed at 73d Street out into Lake Michigan to the Four-Mile Crib. His recommendations resulted in radical changes in the character of tunnel work done in the city. The following year, as chief engineer of the Chicago Bureau of Public Efficiency, he made a survey enabling the city to take ample provisions for protecting its water mains against severe electrolysis.

In 1912 he was appointed engineer of bridges and harbors for the city, to build an organization for handling a great volume of new construction and to approve the design of new bridges provided for by a large bond issue. Notable among these was the Michigan Avenue double-deck bascule which, with its approaches, comprised an $8,000,000 project. One feature of his work was the development of continuous rail joints on the bascules, which were not only conducive to the comfort of car passengers but to the life of the bridges.

Previously, in Indiana, Mr. Hammond had had considerable experience in connection with rail terminals. But in 1914 he started a series of such engagements in earnest. In fact this type of work took much of his time in the succeeding 25 years. He was engaged first as consulting engineer by the Chicago Union Station Company to prepare preliminary plans for the new passenger terminal. The work involved redesigning the trunk-sewer system within a two-mile zone along the Chicago River, the realinement of underground utilities, and preliminary studies for nine solid-floor viaducts. He continued with this company as assistant chief engineer in charge of engineering design and construction of this $75,000,000 terminal until 1922. It is a great and impressive monument to his engineering ability.

From 1922 to 1928 he was with private construction companies on hydroelectric plants, roads, bridges, and buildings—in fact, in general heavy construction work. His consulting practice, begun in 1928 in Chicago, has since been continued. Particularly he has specialized in rail terminals, general structural engineering, and city planning. An enumeration of some of the clients he has served will give an idea of the scope of his efforts—Chicago, of course; Sioux City, Des Moines, and Cedar Rapids, Iowa; Pittsburgh and Philadelphia, Pa.; and the Minneapolis and St. Louis Railroad Company, as well as other railway systems.

In war service, beginning in January 1941, he has held positions of national prominence, first as consulting engineer to the Chief of the Construction Division, War Department, advising on camp construction. Shortly he was appointed as a member of the Construction Advisory Committee, later merged into the Construction Contract Board of the Construction Division, War Department. Only last July he was assigned to duty with the Price Adjustment Section, Construction Division, acting as Deputy Chief of the Section. Here he has been engaged in the renegotiation of all contracts with the War Department.

In the Society he has given generously of his time, on extensive committee work, as representative in various capacities, and as officer in all the grades from Director to President. He has also served in other organizations—as president of the Indiana Engineering Society, as general chairman of the Construction League of the United States, 1933–1934; and finally, as president of American Engineering Council, 1940–1941.

In recognition of his continuous engineering progress, his alma mater, Rose Polytechnic Institute, has given him a number of degrees, starting with the bachelor's degree upon graduation, and followed by M.S. in 1894, C.E. in 1898, and D.Eng. in 1933. He is a member of the Board of Managers of the Institute.

For years Mr. and Mrs. Hammond have lived in Evanston, Ill. Their children are now married and one, Mr. Hammond's namesake, is on active duty as a lieutenant commander in the Navy. Mr. Hammond is mildly interested in golf, but in this has never reached the extreme proficiency of Mrs. Hammond. Speaking of avocations, it is recorded that he once ran for an elective political office and was defeated. From his observation of maturer years, he claims that this was a good thing but fails to state whether it was good for him or good for the electorate.

He still retains the glow of youth, the energy that has made him indefatigable through all the years. His friends everywhere will acclaim him in this, his newest honor. As one of them aptly states, "It is the crowning event of a long and useful career."

LAWRENCE MILTON LAWSON

THE SON of a U.S. Cavalry Colonel who distinguished himself in the Southwest, and the grandson of Amos Lawrence, founder of the Kansas settlement of that name, Lawrence M. Lawson has ably continued the pioneering tradition of his family through a lifetime spent in the development of frontier regions of the Southwest. Born in Washington, D.C., in a house that stood on the site of the present Pantages Theater, he was educated in the public schools of Washington, D.C., in the Mount Tamalpais Military Academy at San Rafael, Calif., and in Leland Stanford University at Palo Alto. As an undergraduate, he had the pleasure of a European tour; and in 1908 he married Marie Macias in New York City. He has two married daughters whose husbands are officers with the armed forces of the United States.

LAWRENCE M. LAWSON

Informal and easy to approach, Mr. Lawson has many wide contacts. These have been made especially during the last decade while he was engaged on work of international scope where his ability to entertain visiting delegations from our good neighbor, the Republic of Mexico, has been very valuable. Doubtless they have aided in no small measure in the success of his many international undertakings. He is particularly interested in promoting good international relations and serves with distinction on the El Paso (U.S.A.)–Juarez (Mexico) civic committee which has charge of such international matters at this, perhaps the most important, civic center on the border.

While engaged, shortly after the turn of the century, in the first surveys of the Colorado and other rivers in the Southwest, Mr. Lawson developed a love for the area and a vision of the vast possibilities for development of this part of the United States. This vision has guided him in the conception and execution of the projects with which he has been connected.

He entered the service of the Department of the Interior in 1903, and in 1905 was assigned to the U.S. Reclamation Service at Yuma, Ariz. There he spent a number of years on flood control and irrigation projects, and as assistant to the supervising engineer of the Southern District of the Reclamation Service. His first assignment on the Rio Grande, presage of a long and intimate acquaintance, came in 1912 when he was appointed project engineer in charge of the Rio Grande Federal Irrigation Project, in New Mexico and Texas. However, his personal knowledge of the Colorado River was again needed, and in 1916 he was recalled to the Yuma project where, as project engineer, he was placed in charge of works which involved an average annual expenditure of $600,000.

Later he was put back in charge of the Rio Grande project and carried out an extensive program of construction of irrigation and drainage works embracing an annual expenditure of approximately $1,000,000. During his ten years as project engineer, he also assisted in the solution of many irrigation and flood control problems encountered along the 200 miles of the Rio Grande. In 1924, he fulfilled satisfactorily a special assignment as engineering representative on the United States–Mexico joint board for flood control investigation in the El Paso–Juarez Valley.

In July 1927, Mr. Lawson was transferred to the Department of State as Commissioner of the United States on the International Boundary Commission, United States and Mexico. He was the first engineer to fill this position since the resignation of Anson Mills in 1914. In this capacity he has negotiated formal and informal agreements with Mexico resulting in the building of large water-control projects along the Mexican boundary, and he has successfully directed the construction of these important engineering works.

His ability in international affairs has been further recognized by the U.S. Government in his assignment as U.S. Commissioner of the Joint Commission, United States and Mexico, for the evaluation of American properties expropriated under the Mexican agrarian law. At the time of his appointment as Boundary Commissioner, many editorial comments were made. One of these, after mentioning his unique qualifications, concluded:

"By enlisting an engineer in the work, and especially one of the peculiar abilities which Mr. Lawson has demonstrated in his work on the Rio Grande Reclamation Project, the State Department has served the country well. There is a genuine place in diplomacy for the engineering type of mind."

This good augury was subsequently borne out in Commissioner Lawson's fifteen years' work on international boundary projects. Their successful prosecution requires not only broad experience in engineering construction but also a high degree of resourcefulness and tact and a deep knowledge of the psychological problems involved. The jurisdiction of the Commission of which he is the American representative embraces all questions pertaining to the location of the land and water boundary between Mexico and the United States, as established and modified by the various treaties.

In 1927, soon after becoming American Commissioner, Mr. Lawson successfully negotiated with the Mexican Commissioner a settlement of the national sovereignty of a large number of tracts of land, known as "bancos," which had been cut from each country by the natural action of the Rio Grande and the Colorado rivers. In 1928 he and the Mexican representative drafted preliminary plans for the straightening of the Rio Grande in the El Paso–Juarez Valley, to provide boundary stabilization and flood control benefits. The detailed plan later developed by the Commissioners formed the basis for the convention of February 1, 1933, between the United States and Mexico, for the rectification of the Rio Grande. One stretch south of El Paso was shortened from 155 miles to 88 miles, and tracts of land comprising 5,000 acres contained in the river bends were exchanged by the United States for an equal acreage similarly cut from Mexican territory. This project established the unique precedent of sovereign nations adjusting their boundary line by peaceful methods.

Many millions have been spent on various Rio Grande projects; and other large expenditures have been planned, all of the American work being under the close direction of this skillful diplomat-engineer.

In spite of the heavy demands of his work, he has found time to contribute articles to various technical publications. Among other professional duties, local and national, he has served on several committees of the Society, including those on Drainage of Irrigated Lands, on Silting, on National Water Policy, on Surveying and Mapping, and on Inter-American Engineering Cooperation (a joint committee).

To recount all the activities of a long and strenuous professional life, covering 40 years of constant advance and increased recognition in the form of greater responsibilities, is unnecessary. Continuously for almost 30 years he has devoted brilliant talents and tireless energy to the international problems of the Lower Rio Grande. Someone has summed it up by saying that he has worked

so long and intimately along the border that he probably knows by its first name every creek, river, rock, and tree crossed by the boundary line.

Well informed and widely read on matters of current history, Mr. Lawson has a keen personal interest in the drama now unfolding in the world and in the inevitable changes that must follow. New scientific developments, inventions, and improvements are subjects on which he is informed, and if there is a possibility of utilizing them to promote economy or efficiency, he is always interested in investigating and testing them. He likes to work with his hands, and has a well-equipped workshop in his garage where he turns out objects of beauty and usefulness, while at the same time his mind is busy with the complicated and delicate problems connected with his position.

He is a student and connoisseur of the opera, rarely missing an opportunity to hear the best ones presented either on the air or on the stage. One of his other diversions is seeing the better motion picture and stage productions, especially those having a historical background or depicting life in the Old West. He enjoys symphonic music. His knowledge of composers, singers, and other notables of the artistic world is extensive. He collects unusual recordings that feature his favorite artists.

Kindly and jovial, slow to anger, deliberate of speech, blessed with a rigid code of justice and honor, Mr. Lawson has the unquestioned loyalty and admiration of his employees. They refer to him affectionately as "The Chief." In appearance, he is unusually tall and erect, has gray hair and a close-cropped military mustache. His blue-gray eyes reflect the warmth of his genuine interest in people and the humor and tolerance resulting from his varied and colorful experiences.

Among friends from New York to San Francisco, and from Quebec to Mexico City, he is famous as a raconteur. Stories having a psychological slant, or partaking of the parable, particularly delight him. No gathering of his staff, or of his intimate friends, is complete without a story told in his inimitable style. As a matter of fact, much of his staff instruction and training is done by utilizing the parable type of story.

Motor cars, and their operation and maintenance, are one of his hobbies; and he takes a personal interest in seeing that the motor vehicles used by his engineering field forces are maintained at their maximum operating efficiency and that they are not driven carelessly or taxed beyond their designed capacities. From a personal standpoint, the word "automobile" is to him just a synonym for the name of one of the better-known American cars which, in various types and models, he has owned and driven since the early motoring days. And he has some remarkable tales to tell of the trials of motoring when roads in the West were largely unimproved trails or trackless wastes.

He smokes cigarettes in moderation but, his friends say, only the "roll your own" variety, a preference doubtless acquired while engaged, as a young man, on surveys in the Colorado River basin. He enjoys good food, and knows how to prepare it. Spending most of his time far from any ocean, he never misses an opportunity to enjoy seafood when he is on the West Coast or in Washington. His friends say that fried shrimp, prepared in the Lawson manner, is a treat for the gods and all good epicures.

Another hobby is his grandson, to whom he is especially devoted and who, he states, is receiving early military training.

His keen sense of humor is evidenced by his unlimited stock of stories appropriate to any occasion. This jovial characteristic is not confined to him alone but seems to run through the whole family. His brilliant wife, conversant with several languages, is a jolly person in her own right. That the daughters have their own fund of humor is exemplified by a single incident.

The Lawsons are necessarily in Washington very often. There they have often made a point of dining at a famous place known under some such designation as "The Barn," and run by a very fine lady. In the course of time they had become well acquainted with the proprietress and had prevailed upon her to stop over at their home in El Paso on one of her trips West. Mr. Lawson delights to tell how the girls helped the maid fix the table for dinner. To her astonishment, the visitor discovered that the spoons were souvenirs from her Washington establishment, apparently secured by the daughters on some of their trips.

In honors, Mr. Lawson has not been lacking. To these he now adds one that must be very satisfying, since it comes from the profession to which he has devoted a lifetime of illustrious work. He thus adds to the luster of Honorary Membership.

BEN MOREELL

IN THE COUNTRY'S greatest emergency it is fortunate in having as head of the civil engineering work of the Navy such a man as Admiral Ben Moreell. Thoroughly trained, tested in the fire of a brilliant and wide naval experience, he seems to have been born for such a day as this. In this brief appreciation of a brilliant man, advantage is taken of quotations from several who know him intimately and love him well.

BEN MOREELL

Although he was born in Salt Lake City in 1892, Ben Moreell moved with his family to New York City when he was two years old, and from there to St. Louis when he was five. And so he looks upon St. Louis as in reality his native town. Recently, however, in a very complimentary speech introducing Admiral Moreell to a distinguished Washington audience, Senator Thomas of Utah proudly claimed him for that state.

All of his schooling was in St. Louis. At 12, after completing the eighth grade, including kindergarten, in six years, he started work during the summer. It is said that he has not had a vacation since. That summer he worked in a shoe factory, doing some kind of cementing, and came home the first day with more cement in his hair than he had put on the shoes. He spent his first week's pay, \$3.00, in the ten-cent store, for pins, needles, and thread for his mother—and his pocket was picked on the way home! Every Sunday morning he got up early and sold papers.

Urged on by his mother, who was a great reader, he devoured all of Dickens' works. He and his sister used to haunt the second-hand book stores, and it was said that they were thrown out of more of them than any other people in St. Louis. His sister still has a copy of *Pickwick Papers* which they bought in one of those stores for 15 cents. Also they didn't neglect *Nick Carter* and *Highbinder* (gory Chinese Tong murder) stories.

In high school he carried five subjects his first two years, and six the last two. Not being satisfied with that, he stayed after school once a week for college algebra, and once a week for college Latin. Every day after school he would fling his books on the table and go out and play ball. His father used to tell him that he was going to flunk. When he brought home his report card with 7 A's and one B, his father said in German, "*Doch ein B!*" He graduated at 16, at the head of his class, and was awarded the honor scholarship to Washington University for four years.

His college career early gave evidence of that all too rare combination of a brilliant student and an outstanding athlete with the ability to give time to both while also working to supplement his scholarship. His interest in track led to his being elected captain of the track team. He also played fullback on the football team. The newspapers always called him "Benny." In one game when Washington hadn't done anything against Missouri for years, Ben ran 70 yards, and tied the score. He was elected a member of both the honorary societies of Tau Beta Pi and Sigma Xi. His alma mater has properly recognized his outstanding career and achievements by conferring the honorary degree of doctor of engineering upon him on June 2, 1942.

He stayed with his native city, St. Louis, in an engineering capacity until he took and passed a competitive examination for a commission in the Civil Engineer Corps of the Navy, in June 1917. After a brief indoctrination course at the Naval Academy, Annapolis, his brilliant career in the service of his country began. He served first as assistant to the Public Works Officer at the New York Navy Yard, and shortly was assigned to more active

war duty as aide on the staff of the Commander, Azores Detachment, Atlantic Fleet. He was also Public Works Officer of the U. S. Naval Base, Ponta Delgada, San Miguel, Azores.

His subsequent duties included service as civil engineer member of the Plant Board, Quincy, Mass.; Principal Assistant and Executive Officer to the Engineer in Chief, Department of Public Works, Republic of Haiti; Principal Assistant and Public Works Officer, Norfolk Navy Yard; Assistant Design Manager, Bureau of Yards and Docks; Public Works Officer, Puget Sound Navy Yard and 13th Naval District; Assistant Design Manager for Carderock Model Testing Basin; Project Manager of the Shipbuilding and Repair Facilities, Storage and Submarine Base Section; Public Works Officer, Pearl Harbor; and finally Chief, Bureau of Yards and Docks, and Chief of Civil Engineers of the Navy.

No description of these varied activities, however, can paint a true picture of his real accomplishments. It is the many things unheralded and unrecorded in such a record, done in between regular routine duties which portray his real character. He is, in fact, nearly always the first man at the Bureau in the morning and among the last to leave at night. He sets an example which junior officers feel obligated to follow and they do follow it willingly. He has no patience with people who wait for things to come to them to be done. He preaches and practices the doctrine that hard work is the best road to success and that there is no substitute for it. He once told a friend, "If you can't find enough work to keep busy, you can always write a book." That is just what he himself did. The result was his *Standards of Design for Concrete*, which was and still is one of the outstanding and most widely accepted treatises on concrete.

Up to very recently, Admiral Moreell has continued to take an active part in concrete research and studies. In June 1932, the Navy Department sent him to France to take a special course at the École des Ponts et Chaussées in Paris. He had become very proficient in the French language during his four years of duty in the Republic of Haiti, 1920 to 1924. This stood him in good stead when he went to Europe and he soon became a polished French linguist, and still is. After his return he continued his concrete research work. Applying some of the information he had gained in Europe, he wrote a treatise on "Articulations for Concrete Structures," for which the American Concrete Institute awarded him the Wason Medal.

Speaking of medals, two special ones of honor and merit were struck off and conferred on the Engineer-in-Chief of Haiti and his Executive Officer by the President of that Republic when they finished their four-year period of service there. The Engineer-in-Chief was the then Commander (now Rear Admiral) A. L. Parsons, and his Executive Officer was the then Lieutenant Moreell. Subsequently, the latter was also awarded the Order of "Honneur et Merite," grade of Commander, by the Haitian Government.

He is a member of, and has been signally honored by, many societies both technical and social. He is past-president of the American Concrete Institute; past-president of the Society of American Military Engineers; vice-chairman, Washington Committee of the Newcomen Society of England; and has served three terms as president of the Army and Navy Club in Washington. Whatever the organization with which he may be actively connected, it isn't long before Ben Moreell is singled out for consultation and advice. He never accepts such a job unless he feels he can devote sufficient time to it to take a constructive part.

Those who meet Admiral Moreell for the first time are always impressed with his dynamic personality, direct and forceful, brief and to the point, but friendly to a great degree. Even for first acquaintances he always has a humorous story to suit the occasion or illustrate the point. To his associates, high and low, he is known and addressed as "Ben." This is his real name, not Benjamin. His juniors and subordinates fondly speak of him—when he is not present—as "Big Ben, the boss." While he wastes no time, one of his charming assets is that he always takes time to talk to the people who come to see him, and to listen to their stories, probably to a greater extent than does any other high-ranking officer in Washington today. This, of course, has not only made him many friends, but also has developed a widespread feeling of confidence in him.

At the time of his appointment to Chief of the Bureau of Yards and Docks, December 1, 1937, he was forty-five and one of the youngest Naval officers to be appointed to the rank of rear admiral and chief of a bureau of the Navy Department. His supporters, and they were many, made no mistake. He is a leader of the highest type. He commands respect and inspires confidence and affection in his entire organization. One of his favorite pieces of advice to a new officer is, "When given an order to do something, never say, 'I'll do my best'; say, 'I will do it.'" He has a tremendous capacity for work and the rugged physique to stand it. An average of twelve hours or more a day, seven days a week, is his schedule.

There is a very human side to his character—he likes to play also, but he says there is no time for that until this war is won and the aftermath is cleaned up. His hobbies are mostly hard work of all kinds, but he loves his home; he and Mrs. Moreell and their two fine daughters are all great pals and have a good time together.

One will find his office and study at home lined with autographed photographs of many of the most prominent men of the time, civilian as well as military. But interspersed among the great are other friends of whom few have ever heard. He has the hobby of collecting quotations pertinent to the time, and his office walls are well covered with the best ones. Many of his visitors are interested and often take away some very good ideas.

He used to be an excellent tennis player but now he prefers a game of golf when there is time, which is seldom these days.

It is willingly admitted by "those who know" in Washington as well as by his associates of the Navy, that Admiral Ben Moreell is one of the best witnesses among the ranking military officers who testify before Congressional committees "on the Hill." This is one of the places in particular where his amazing grasp of details and unusual memory quite astound his inquisitors as they do all his friends. These men have learned that they can place confidence in what he says, and he numbers among his friends many of those who count "on the Hill."

One of his favorite topics these days is the "Seabees." He can well be proud of his creation, the Naval Construction Battalions, the newest arm of the Navy, organized to build, defend, and maintain the shore bases for the support of the Fleet beyond the continental limits of the United States. Proudly he will tell his visitors of the fine letters from Admiral Nimitz, General Holcomb of the Marines, and many other ranking officers in the combat theaters, which give the highest praise to the deeds of the Seabees. He is truly proud of his recent title by the press, "Admiral Ben Moreell, King Bee of the Seabees."

He is a fine impromptu speaker, often in a humorous vein. When he makes a serious speech, he writes it himself. His recent broadcasted and widely publicized speech before the Convention of Building Trades Unions at Toronto, Canada, was credited in several editorials as being one of the three outstanding constructive public speeches of the past year. Always sympathetic to the problems of labor and one of its staunch friends, he numbers among his friends most of its leaders. This speech very well typified his characteristic approach and solution of problems—a painstaking and accurate analysis of the subject, a blunt and forceful presentation, logical conclusions, and constructive recommendations.

Summing it all up—Admiral Moreell is a top-ranking Naval officer and engineer of whom the people of this country may well be proud, and in whom they may place their confidence. He can be trusted to play a large part in leading this country to a complete victory and a lasting peace. He is the type that engineers love to single out as worthy of professional preferment, such as the present Honorary Membership. In the words of one of his close associates, he "merits the very best that one can say about him."

BREHON BURKE SOMERVELL

It is proverbial that engineer-officers, as men of varied parts, are called upon to handle a great diversity of problems. Brehon B. Somervell is an outstanding example of this fact. There is also a lurking impression, attested likewise by experience, that the most capable officers have opportunities to go fast and far in the Army. General Somervell is a notable example of this fact, too.

There are ample reasons, as anyone who investigates his development will readily observe. He started with a good inheritance; his parents were from medical and educational backgrounds. With all innocence, he claims to be "just a country boy from Arkansas," but that fools exactly nobody—his tongue is obviously in his cheek. As a matter of fact, he grew up in Little Rock, the largest city in the state, and during his teens the family moved east to Washington, D.C., whence he went to West Point.

BREHON B. SOMERVELL

This appointment was one of the first acknowledgments of his superior qualities. Even among this group of selected men he shone brilliantly, graduating sixth in his class. Such are the reputation and the practice of the Engineer Corps that regularly the new second lieutenants choose that field in preference to others. So it was with Somervell—luckily for him, and especially luckily for the Corps and the profession.

At that moment, basic military and engineering forces were at work in the world. He found himself immediately in the midst of World War I. It happened in this way: he had secured a special leave upon graduation to spend a few months in Paris and was there when the catastrophe of 1914 occurred. Never one to shun responsibility, he immediately found work as assistant military attaché at the American Embassy helping to repatriate stranded Americans. It is said that he handled a million or more dollars in this manner—no small responsibility for a young man barely out of school.

Again, when he returned to America, great events were in the making and he found himself immediately on the Mexican frontier. This was a brief assignment and not so important in the light of subsequent events. But it did give him added training, greater breadth of view, and wider acquaintanceship in the Army.

He was among the first to get over to France with engineer troops, spending a year on engineering work before getting himself assigned to an infantry regiment. His work must have been eminently satisfactory for he progressed rapidly in those two years from second lieutenant to lieutenant colonel, dropping back to the permanent grade of major after the war.

His duties, following the Armistice, took him to Coblenz as assistant chief of staff in one section of the Army of Occupation. This assignment had quite unexpected results in that he met an American girl, Anna Purnell, on Y.W.C.A. work. She became Mrs. Somervell, then and there, and lived long enough to gratify her ambition to see her husband's ability given substantial recognition in the Army. He also met and worked with Walker D. Hines, an association productive of mutual esteem, which later led to further contacts to the advantage of both.

While most of his subsequent work was confined to the continental United States, two interruptions did occur, both resulting directly from his war service. In 1925 he spent six months on special assignments requested by Mr. Hines, helping him to complete a survey and report on Rhine and Danube river navigation for the League of Nations. Again, in 1933, Hines secured his assistance in making a general economic survey of Turkey for the Turkish Government. Hines himself did not survive this appointment, but Somervell completed the voluminous report, following detailed studies which had taken him all over the country. He returned to America a year to the day after he had left.

Except for these notable exceptions, however, Major (later Lieutenant Colonel) Somervell spent most of the post-war years in civil activities. He was special assistant on construction, Office of the Chief of Engineers. He served as assistant or district engineer in various offices—New York City, Washington, Norfolk, Memphis, and Ocala, Fla. In the latter position he was in charge of the construction of the Florida Ship Canal when that great project was in the limelight. For other periods he was special assistant to the President of the Mississippi River Commission, and a member of the Beach Erosion Board and of the Shore Protection Board of the War Department.

Meanwhile an entirely different aspect of his career was developing. It was allied to engineering but it involved also sociology, psychology, and economics. Details of duty outside the Engineer Corps included those as executive officer, National Emergency Council, and regional engineer for the Southeastern area, Works Progress Administration. Shortly afterward, he made a survey and report for the WPA on its activities in New York City. On August 1, 1936, he assumed office as administrator of this tremendous work.

For reasons peculiar to local conditions, this assignment brought him into national prominence. The job was no bed of roses, and Colonel Somervell was not chosen for it with any idea of giving him a rest. On the contrary, it was considered a man-killer. Many persons had preceded him, trying to manage New York City's work relief system. None had completed a full year and at least one was supposed to have been killed by overwork. Aside from his natural qualifications, Colonel Somervell had other incidental advantages—he was an Army officer, young but of relatively high rank; he was known to be a disciplinarian, rather hard-boiled; and he was being paid by the Army, and the assumption was that his services could be withdrawn at any time. But they were not withdrawn. To the contrary, and belying all predictions, he made of the work an outstanding success and of himself a marked man, nationally.

Heretofore, every tendency of the system had worked against the administrator. He had to satisfy the city authorities, public criticism, and worst of all, the vast army of clients. Sooner or later these factors and a multitude of other complications had invariably led the administrator into pitfalls, surrender, or abdication. Not Somervell. To the astonishment of his waiting critics, he straightened out matters immediately and continued to run the complicated affairs of the WPA in New York City with genuine success and general approval for a matter of over four years. One of the greatest accomplishments from an engineering point of view was construction of LaGuardia Field, which job he described most interestingly in the April and May 1940 issues of CIVIL ENGINEERING.

With the outbreak of the present war, his progress in official stature and public esteem was no less then phenomenal. In the space of a few short months he rose from lieutenant colonel to brigadier general, to major general, and finally to lieutenant general, in charge of the Services of Supply Division. Thus, as one of the highest hierarchy in American military circles, he has been responsible for more construction and more production than any other man in history within a similar period. His ultimate promotion came as a result of further successes, this time in the field of cantonment construction under the Quartermaster Corps, of which he was chief. But these developments are so recent as not to require elaboration here.

Naturally, the question arises, just what sort of a superman must he be—a lieutenant general, almost at the top of America's might, at the age of 50. The answer is that he is endowed with many extraordinary qualities. He has the knack of getting things done with a certain quiet efficiency. Not that he fails to appreciate some of the finer points of diplomacy. Rumor has it that, even as a youngster, he turned up on one of his early assignments with a box of cigars for presentation to his superior. His artistry was apparent not in the gift alone but in the fact that it was the particular brand the man especially liked. That older officer had the opportunity to be Somervell's friend and mentor for years thereafter.

He is a hard worker; he is a disciplinarian; he is an incisive executive. He has that rare combination of analytical mind and executive ability. He is at once fair and rigid, urbane and tough. But he is not ostentatious, and he gets along with all manner of people remarkably well.

Hard work is a byword with General Somervell. He drives his associates to the last ounce of capacity but he seemingly drives himself even harder. He has no use for inefficiency and this attitude, strikingly enough, made quite a hit with those interested in his WPA adventure. Lest it be presumed that he is all work and no play, it should be said that he loves sociability—in its place. At social activities he is the polished gentleman, a raconteur of note. His family includes three daughters; his home is typical American.

Of course, General Somervell studied at the Army Engineers School, the Command and General Staff School, and the Army War College, where he completed his military education. For outstanding services he has been awarded the Distinguished Service Cross and the Distinguished Service Medal. In May

1942 he received an honorary doctorate in military science from Pennsylvania Military Academy.

Engineers are proud of General Somervell because he represents what to them are the finest attributes of the profession. His friends will tell you that they always knew he would reach the top, that "he has what it takes." And they are sure that he will run true to form in this war emergency, shedding continued glory on the profession that he has already so highly ornamented. It is this confidence, born of past performance, that has singled out General Somervell for the further distinction of Honorary Membership.

SHERMAN MELVILLE WOODWARD

Ordinarily engineering practice is considered a prerequisite for engineering teaching. In the case of Sherman M. Woodward, the order has been reversed; after an ordinary lifetime of experience in teaching, he has devoted almost a decade to important practical work. This reversal of the normal order is more than a peculiarity—it is a fine tribute to the many-sidedness of this unusual man.

His life history and most of his experience have been closely interwoven with the great Mississippi Valley. Few men know it from intimate experience as well as he. Inheritance as well as association may account for this. His father, Emerson J. Woodward, left the shipwright's trade in Massachusetts to take up a Minnesota homestead in 1854; his mother, Amelia Scaife, had come from Vermont a year earlier. The Sioux Indian outbreaks of the early sixties drove them, with the other settlers, to the vicinity of Fort Snelling, Minnesota, for protection. Emerson Woodward served in the Union Army throughout the Civil War. The war seems to have been but an interlude in his plans, for on his return he married and purchased a farm near Richfield, where the family lived for many years. Besides running the farm, he turned to the tools in the carpenter chest that he had brought from the East, and erected many of the buildings in what was still a pioneer community.

Sherman M. Woodward

Here their four children were born, including Sherman M. Woodward. The date was May 11, 1871, and the place, near Minneapolis. His boyhood followed the pattern that was typically Mid-Western for half a century. The curriculum in the country schools of the day was limited by the impediments of winter snows, muddy roads, and poorly prepared teachers. He supplemented such instruction as was available by thorough self-training in arithmetic and elementary algebra.

At the age of fifteen he was sent to the Manual Training High School in St. Louis, which had been founded by his uncle, Calvin M. Woodward, and was the original of the modern vocational schools. In 1888 he matriculated in the engineering course in Washington University, where his uncle was professor of mathematics and mechanics for many years. Here a vast store of knowledge was opened to an inquisitive mind. There is evidence of hard work in a thick volume of plates in descriptive geometry which he proudly displays, all rendered in ink with meticulous care—a task that would stagger a freshman of today. When Sherman Woodward graduated in 1893 he received a citation, *summa cum laude*, the only member of his class to earn this honor.

After a brief period of high school teaching and a year in graduate study at Harvard, he was for eight years professor of mechanics and physics at the University of Arizona. In addition to his teaching duties, he devoted much time to studies of irrigation, hydrology, and similar problems of the Southwest. When the late William G. Raymond, M. Am. Soc. C.E., was appointed head of the Department of Engineering at the University of Iowa in 1904, he exercised the care which was characteristic of him in selecting his teaching staff. Mr. Woodward was appointed professor of steam engineering. After one year at Iowa, he spent three years as irrigation and drainage engineer on special studies for the Department of Agriculture under the late Charles G. Elliot, M. Am. Soc. C.E.

With this preparation he was ready to enter upon a truly great career in engineering. In 1908, after establishment of the College of Applied Science at Iowa, Dean Raymond induced him to return, as professor and head of the department of mechanics and hydraulics. He continued to serve in this capacity for 26 years.

During this time he not only established a reputation as an outstanding teacher and an eminent hydraulician, but became a leader in the cultural and civic circles of Iowa City. He was prominent in faculty activities, a Rotarian, President of the Iowa City Savings Bank, a member of the City Council, and for many years secretary of the Iowa Engineering Society. One of his favorite winter sports was to set out up the Iowa River in the evening on skates, often alone, dodging air holes in the dark.

In the classroom, as elsewhere, he has always been modest and unassuming, never resorting to pose to sustain his leadership or to create impressiveness. His teaching methods have always recognized the individual capacities of his students—for the plodder, patience in seeking fundamentals; for the average, an illuminating presentation rather than a rattling of dry bones; for the brilliant, a challenge to the fullest exercise of their capabilities. The good will and friendliness which accompanied these efforts inspired a respect and confidence which the old graduates have carried with them through the years.

At intervals during his stay at Iowa, Mr. Woodward devoted considerable time to consulting engagements. From 1913 to 1920, he was consulting engineer for the Miami Conservancy District at Dayton, Ohio. He was to a considerable degree responsible for establishing the fundamental concept of a complicated flood control problem. Among his other achievements at this time were the extension of the theory of the hydraulic pump and the first deliberate large-scale application of this phenomenon to the dissipation of energy in a high-velocity stream.

Among other consulting engagements were those for the Pueblo (Colo.) Flood Protection project; for the Sanitary District of Chicago on the diversion of water from Lake Michigan; for the Illinois Central Railroad in connection with litigation arising from the construction of the Bonnet Carré Spillway; for the Mississippi Valley Committee; and for the Tennessee Valley Authority during the inception of Norris and Wheeler dams. It will be noted that these activities involved the length and breadth of the great Mississippi Valley, from the far West to the very East, from the Great Lakes to the Gulf of Mexico. Such was the breadth of his interest and similarly the extent of his reputation.

It was a great strain to pull up his roots in Iowa, to leave his many friends, many of whom sincerely counseled him to stay. But the time came when it seemed to him proper and desirable. In 1934 Mr. Woodward resigned his professorship and became Chief Water Control Planning Engineer for the Tennessee Valley Authority. Here his clear perception and integrity of purpose have been invaluable in resolving many of the apparent conflicts inherent in the conception and operation of multi-purpose projects. In this work his talent for practical hydraulics found wider scope. The engineering features of this work have received wide acclaim, even from those who did not approve all other aspects of the extensive project. This acknowledgment is to the great credit of the profession as represented in the TVA, and it is especially to the honor of Mr. Woodward.

After a long connection with the Society, he was recently made a Life Member. He is also a member of the American Society of Mechanical Engineers, of the Society for the Promotion of Engineering Education, of the American Association for the Advancement of Science, of Sigma Xi, Tau Beta Pi, Rotary, the Irving Club, and the Knoxville Technical Society. His writings are liked by hydraulic engineers for their lucidity. Many bulletins and reports have come from his pen, mostly dealing with hydraulic engineering. He is co-author, with C. J. Posey, Assoc. M. Am. Soc. C.E., of a recently issued volume, *The Hydraulics of Steady Flow in Open Channels*.

The many engineering and scientific achievements, in consideration of which Mr. Woodward has been elected to Honorary Membership in the Society, represent only one side of a many faceted nature—genial as well as keen. Never a brass hat, never hurried, and with no consuming ambition, among his many friends and associates he is known as a gentleman and scholar, a delightful companion, a sincere friend, with a love for humanity, a deep appreciation of the values of life, and a whimsical understanding of its trivialities. His even disposition under all circumstances and his unfailing courtesy to everyone are two of his outstanding characteristics.

His fine sense of humor goes far to make his friendship worth while. He is quick to see the lighter side of a situation and to call to mind an appropriate story or anecdote to give it emphasis. In this connection, his sense of balance and proportion in human relations is one of his most interesting attributes. He always seems able to see through sham and pretense, and to appreciate the absurdities that go with the efforts of people who are pretending to be what they are not or who are taking credit for results obtained by associates or subordinates. He goes out of his way constantly to give credit to his own subordinates for creditable work, the origination of which, and the greatest share of credit for which, by all means belong to Sherman Woodward.

His combination of ability and disposition result in a mind that is keen and erudite, and he is both able and willing to talk in an intelligent and pleasing manner on almost any subject that may come before a group. He is a fine companion, always gracious either as host or guest. Needless to say, no one could have accomplished as much as he has in a lifetime without an abundance of energy; of course, his has been a somewhat quiet energy in late years. But he still continues many of the activities of earlier years, organizes book clubs and dancing classes, teaches groups of the younger men after hours, attends City Council and School Board meetings, and withal is never too busy for an enlightening discussion with anyone who seeks his opinion or can satisfy his insatiable curiosity. His home in Knoxville with Mrs. Woodward and their three daughters is popular with all his engineering friends.

Of his present accession to Honorary Membership Mr. Woodward is fully worthy, both as a man and as an engineer. Some of his close associates have given their tribute to him in the December 1942 issue of *The Tennessee Valley Engineer*. Of his work there, Chief Engineer T. B. Parker, M. Am. Soc. C.E., states that "one of his greatest contributions to the engineering profession has been that made as Chief Water Control Planning Engineer, having responsibility for the planning and operation of the unprecedented integrated system of reservoirs constituting the TVA System." In the same connection one of his old-time engineering associates in Iowa, Prof. B. J. Lambert, M. Am. Soc. C.E., expressed this conviction regarding Mr. Woodward: "He was one of the best, if not the best teacher I ever knew. He is a well-educated gentleman."

It will be clear to anyone who cons these lines that Sherman M. Woodward is eminently fitted for this latest tribute—Honorary Membership.

Saving "Proceedings"

A Society member has a problem on his hands. He writes:

"Please let me know how you determine which articles from the monthly issues of the PROCEEDINGS are to be reprinted in the TRANSACTIONS number at the end of the year, so that I can have some basis for deciding whether it is worthwhile for me to carry all of the monthly PROCEEDINGS in my wanderings."

His query may find response in the minds of many members faced with a similar question. Hence the comments of the editors on this question may have a general application.

With the exception of progress reports, all technical papers and discussions are now published in TRANSACTIONS. Before 1930 there were certain exceptions to this rule, but since that time it has been consistently followed. There is a consistent standard procedure in the publication of Society reports: Progress Reports are offered to readers in PROCEEDINGS, as the tentative judgment of a committee. The sole purpose of publication in PROCEEDINGS is to afford the membership a chance to contribute ideas for the final report. The final report is published in TRANSACTIONS only, not in PROCEEDINGS.

A progress report almost never has a closing discussion. The sponsoring committee's reaction to the discussion of a progress report may be reflected in subsequent progress reports or in the final report. The Committee on Publications may (and often does) rule that discussion of a progress report shall not be published at all, but shall be transmitted directly to the authors of the report for possible use in preparing subsequent reports.

Purposely PROCEEDINGS has been designed so that members may tear them apart and save the papers and reports most interesting to them until the collated and indexed TRANSACTIONS volume containing these sections is available. Papers not included for any reason in the TRANSACTIONS are listed in the front of each yearly volume, at the end of the index section. Most of these papers are destined for inclusion in the following number.

A Notable Year for Membership Applications

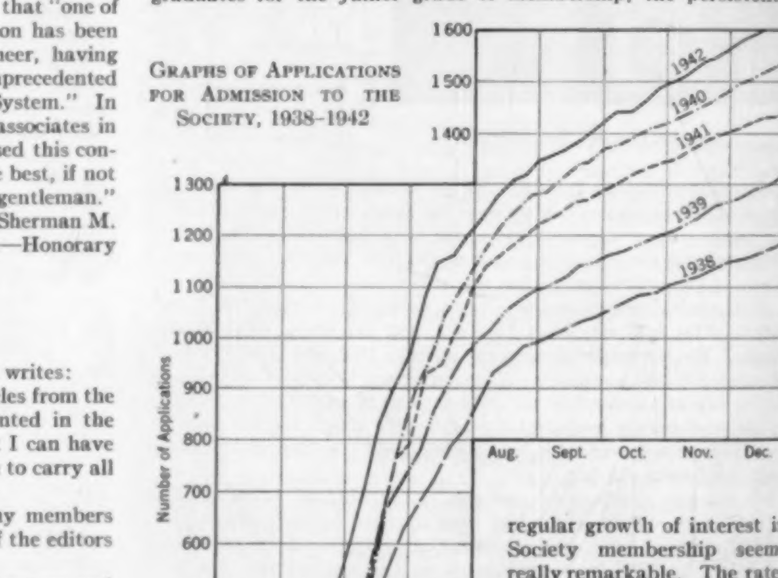
THE ATTACHED graph showing the cumulative numbers of membership applications received in the past five calendar years, starting in each case on January 1, might be entitled "Picture Without Words." It certainly does speak for itself.

Two features of the diagram are notable. First is the fact that there is a tendency toward increasing numbers of applications since 1938. The year 1940 showed a material improvement over 1939. While 1941 did not reach the heights of 1940, yet 1942 again showed a considerable superiority over both 1940 and 1941.

Secondly, it should be noted that the curves have a marked similarity in pattern. Generally speaking, the curves appear to follow three trends, which however are really only two. One of these embraces the latter third of one year and the succeeding early third of the following year. In other words, if the curves of two successive years were made continuous, these parts would appear as almost a straight line. The generally straight section covering the middle third of the year is much steeper than the remainder. This is a graphic representation of the large influx of graduating professional engineers who apply for membership at approximately the same time each year.

Except for the period when applications are made by student graduates for the Junior grade of membership, the persistently

GRAPHS OF APPLICATIONS FOR ADMISSION TO THE SOCIETY, 1938–1942



regular growth of interest in Society membership seems really remarkable. The rates at which graduating students make application for Junior membership in successive years also, it is to be noted, tend to increase yearly. The Society may be expected to continue its appeal to those civil engineers, young and old, who are vitally interested in their professional status and their professional advancement.

Civil Engineers' Contractual Relations with War Department

By HAL H. HALE, M. AM. SOC C.E., ASSISTANT TO THE SECRETARY, WASHINGTON, D.C.

DOUBTLESS many engineers will be interested and some should be concerned about two orders issued by the Office of the Comptroller General of the United States. The first was Order B-18126, dated December 18, 1941, the second was Order B-28736, dated November 14, 1942. These orders deal with cost-plus-fixed-fee contracts for professional services.

When the seriousness of the present emergency became apparent, it was realized that the Secretary of War would need to act rapidly to provide the necessary facilities for our armed forces. On August 7, 1939, the Congress passed an Act (53 Stat. 1239) authorizing the Secretary to do so. This Act said, in part:

"Whenever deemed by him to be advantageous to the national defense, and providing that in the opinion of the Secretary of War the existing facilities of the War Department are inadequate, the Secretary of War is hereby authorized to employ, by contract or otherwise, outside architectural or engineering corporations, firms or individuals for the production and delivery of designs, plans, drawings, and specifications required for the accomplishment of any public works or utilities project of the War Department .... In no case shall the fee paid for any service authorized by this section exceed 6 per centum of the estimated cost, as determined by the Secretary of War, of the project to which such fee is applicable."

Legislation supplementing the original Act was passed on June 13, 1940 (54 Stat. 350), and on July 2, 1940 (54 Stat. 712). By Section 1 of the Act, the Secretary was authorized to award construction contracts on a cost-plus-fixed-fee basis with a specified limitation on the amount of the fixed fee; Section 2 of the Act, on the other hand, did not mention fixed fee, but did place a limitation of 6% of the original estimated cost on the actual fee to be paid the engineer.

ORIGINAL ESTIMATED COST BASIS FOR FEE

Under authority of these Acts, the Secretary proceeded to award contracts for professional services on a cost-plus-fixed-fee basis and many engineering firms accepted, and completed, contracts under these terms. Rulings were subsequently issued that made the original estimated cost the final basis for computing the fee, and this ruling held, even though in many instances the final costs were double and sometimes treble the original estimates. The natural result was that the total paid the engineer in fixed-fee plus the reimbursable costs, in some instances, exceeded considerably 6% of the original estimated cost of construction.

The question of payments in excess of the statutory limitation was then raised. The Secretary of War took the position that the reimbursable costs should not be considered as a part of the engineer's professional fee. The Comptroller General interpreted the statutes otherwise and held in Order B-18126, issued December 18, 1941, that reimbursables (with certain exclusions) should be considered as a part of the engineer's fee. In the conclusion of the order, the Comptroller General said:

"Accordingly, I am constrained to hold that, under the limitation imposed by section 2 of the Act of August 7, 1939, payments to architect-engineers employed under contracts authorized by that section may not exceed six percent of the estimated cost of the project, regardless of whether such payments are made as reimbursement of expenditures or as a fixed fee. . . ."

Under subsequent interpretations of that ruling, engineering firms would have had to forfeit not only their fee, but additional moneys out of their own pockets. Such a position was untenable.

NEW ORDER ISSUED

Section 2 of the Act (53 Stat. 1239) said that the 6% limitation applied to the "production, and delivery of the designs, plans, and specifications required for the accomplishment of any public works. . . ." No mention was made of costs incurred in field supervision of the work, which customarily are not covered by percentage or lump-sum fees. The Comptroller General has now issued a new order (B-28736, November 14, 1942) which provides that: ' . . . where contracts cover both the preparation and delivery of designs, plans, etc., and the furnishing of supervisory services, the provision in the act of August 7, 1939, limiting fees of architect-engineers to 6 percent of the estimated cost of the project involved applies (only) to that part of said contracts which covers the 'production and delivery of the designs, plans, drawings, and specifications. . . .' "

Engineers must follow the procedure outlined in the following provision of the latter order (B-28736) to benefit from the second ruling:

"However, in order that this office, in the audit of vouchers under the foregoing and similar contracts, may ascertain whether the amounts paid to the contractor (engineer) as reimbursement of expenses and as fees for the preparation and delivery of designs, plans, drawings, and specifications, do not exceed 6 percent of the estimated cost of the project involved, there should be forwarded here, for attaching to the contract, upon the completion of each project, an itemized statement containing a detailed breakdown of the total amounts paid under the architect-engineer contract showing the nature and amounts of the expenses and fees paid to the contractor (engineer) for the work of preparation and delivery of designs, plans, drawings and specifications, and showing, also, the nature and amounts of expenses and fees paid to the contractor (engineer) for the services of technical supervision. Otherwise this office will be required to withhold credit on vouchers covering payments under said contracts."

Engineers who now have, or who have had, cost-plus-fixed-fee contracts with the War Department should immediately review their situations in the light of the Comptroller General's Orders B-18126 and B-28736, in order that their interests may be properly protected.

Frederic R. Harris Wins Construction Engineering Prize

THIS year the Construction Engineering Prize—given annually for the best original scientific or educational paper on construction published in CIVIL ENGINEERING—goes to Frederic R. Harris, M. Am. Soc. C.E., for his paper, "Evolution of Tremie-Placed Dry Docks," which appeared in the June issue.

This is the fourth award of the Construction Engineering Prize, the first having been made in 1939. The prize was established in that year through the generosity of A. P. Greensfelder, M. Am. Soc. C.E., and is the only prize specifically limited to material appearing in CIVIL ENGINEERING. The award is made on recommendation of the Executive Committee of the Construction Division, followed by approval of the Board of Direction. In accordance with the customary procedure, presentation of the prize will take place at the Society's Annual Meeting held in New York in January.

In the first World War, Admiral Harris was chief of the Bureau of Yards and Docks; general manager of the Emergency Fleet Corporation; and president of the Board of Control, War Construction. He retired from the Civil Engineering Corps of the Navy in 1927, with the rank of rear-admiral. Since then he has headed the engineering organization bearing his name, which has specialized in river and harbor works, and graving and floating docks. His organization is directly retained, and in association with three other engineering firms, on the design of various large graving docks, Navy Yard extensions, and other installations for the Navy. It is also designing floating docks of timber and steel, all of which are innovations as regards type, for the Navy and for the British Admiralty.

Admiral Harris was graduated from Stevens Institute in 1896, receiving the M.E. degree, and in 1921 was awarded the honorary degree of doctor of engineering.

FREDERIC R. HARRIS

Life Memberships Are Awarded to 162

ON JANUARY 1, 1943, more members of the Society will become exempt from dues and join the ranks of Life Members. In accordance with a constitutional provision, those who are 70 years old and have paid dues as Corporate Members for 25 years and those who are less than 70 and have paid dues for 35 years are thus exempt.

In 1938 the Society initiated the policy of recognizing this long period of service by the award of certificates of life membership, which carry with them the remission of all further payment of dues.

A number of the Local Sections have adopted the custom of presenting these certificates with a special ceremony at a Local Section meeting. Where no such programs are planned, the certificates are mailed direct from Society Headquarters. The accompanying table lists a total of 163 members who will attain this distinction on January 1. Two other members of the Society—Marius Schoonmaker Darrow and Frank Sears Senior—were originally listed in this table, but died in recent months.

Many interesting letters have been received at Society Headquarters from members who have been informed of their life membership status. They express their appreciation of the honor in such words as the following:

"I consider this action of the Society a milestone in my engineering career and trust I will carry on the membership for some time."

"Although I am a member of a number of professional and technical societies . . . , I have always valued my membership in the Am. Soc. C.E. as the greatest honor."

"Your letter notifying me that I am to become a Life Member has been received with mixed feelings. I appreciate the honor, but at the same time I am reminded that I am approaching the biblical span of 'three-score years and ten.' However, I shall expect to carry on in the Society's interest, as I have done in the past." Thirty of this member's 35 years of membership have been spent as a member of one Section.

In this same vein another member writes, "It was somewhat of a surprise to me to learn that I have been a member of the Society for 35 years. It makes me feel very old. It is very nice not to have to pay any more dues."

And still another says, "I used to look with a good deal of pride and envy upon what we might class as the elder statesmen. When I find myself considered for such a niche, I am frank to confess that I approach it with mixed feelings. . . . I have the warmest appreciation of the Society and its work."

Many take this opportunity to say what the Society has meant to them. Typical of such letters is the following: "Membership has meant much to me in the past 35 years. It has been helpful in business as well as social life. It has helped me over some rough spots and has been the source of many warm friendships. My wish is that it [the Society] may grow in strength and usefulness. . . ."

Another, who is also rounding out 35 years of membership, writes, "It has meant much to me to have been a part of the Society through years of partial invalidism, and to have the publications available for use."

Yet another says, "I duly appreciate, and have always appreciated, the honor of being a member of our body of distinguished men, and I take occasion now to acknowledge gratefully the benefits that have accrued to me from association with them."

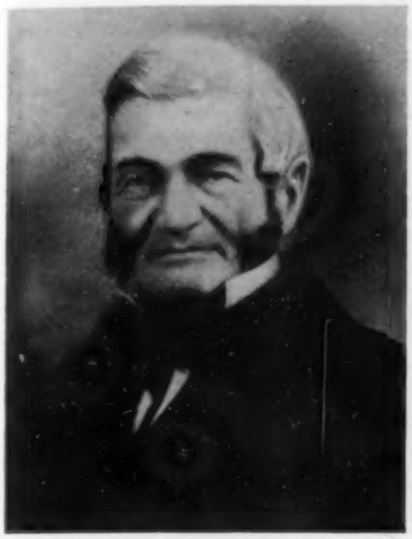
MEMBERS EXEMPT JANUARY 1, 1943

Agramonte, Albert Arthur
Allen, Robert Livingston
Alsberg, Julius
Ammann, Othmar Hermann
Anderson, Charles Louis Bates
Baker, Harold James Manning
Barkmann, Ernst Henry
Barlow, John Sadler
Barnes, Frank Edwin
Beach, William Nicholas
Becker, Sylvanus A.
Belcher, Wallace Edward
Boardman, Horace Prentiss
Bond, Judson Baker
Boyd, Robert Wright
Branch, Lester Van Noy
Brillhart, Jacob Herbst
Brinkley, Milo Hamilton
Brown, Perry Fisher
Bruning, Henry Diedrich
Buel, Emott Davis
Bullen, Jacob Thompson
Burwell, Robert Lemmon
Carberry, Ray Sheppard
Carpenter, Edward Emery
Chandler, Elwyn Francis
Charles, La Vern John
Clarke, Elwyn Lorenzo
Collins, Charles Dickey
Cone, William Smith
Cooke, George Richardson
Coomer, Ross Miller
Cother, Albert Adiel
Coulter, Waldo Scarlett
Covert, Clermont C.
Crawford, Joseph Emmanuel
Darnell, James Lee
Davis, Lynn LeRoy
De La Mater, Stephen Truesdell
Drowne, Henry Bernardin
Dutton, Charles Henry
Eckles, Harry Edward
Ely, John Andrews
Esselstyn, Horace Hovey
Evans, Robert Rogers
Feltham, Percy Marshall
Fenstermaker, DeWitt Clinton
Fleming, Harvey Brown
Follansbee, Robert
Gallagher, James Pelton
Garman, Harry Otto
Gaylord, Laurence Timmerman
Gearhart, Walter Scott
Giles, James Marvin
Gilman, James Beatty
Goodwin, George Estyn
Gough, William Joseph
Grant, William
Hadwen, Theodore Lovel Donner
Hamilton, Farrar Petrie
Hansen, Paul
Hardman, Roy Cordis
Harkness, George Edward
Harvey, Herbrand
Hasley, Thomas Richard
Hazard, William Abbott
Herrold, George Herbert
Hewins, George Sanford
Hill, George Hammeken
Hilt, Fred Keating
Horton, Dwight Fred
Hough, Ulysses B.
Howard, Lewis Thomas
Hulbert, Everson Clifton
Hunt, William Henry
Hunting, Eugene Nathan
Johnson, Arthur Augustine
Jones, George Paxson
Kemp, John Edward
Kinsey, William Ambrose
Knox, Schuyler Brush
Koon, Ray Emerson
Lahmer, John Aloysius
Lange, Theodore Ferdinand
Larrison, George Kirkpatrick
Leeson, Robert Vonartievelde
Leighton, Marshall Ora
Lindhé, John Birger
Long, John Coleman
Lowther, Burton
MacCornack, Clyde Webster
McDonnell, Robert Emmett
McGonigle, Charles Joseph
Marshall, Thomas Worth
Maughmer, Carl
Minor, Edward Eastman
Moore, Frank Cook
Moore, Lewis Eugene
Morris, William Cullen
Moser, Charles
Muhs, Frederick Ross
Murray, Samuel
Neeld, Charles Marshall
O'Connor, John Adam
O'Hearn, John Lynch
Palmer, Charles Walter
Parker, John Castlereagh
Patterson, Robert Youngman
Payne, Edwin Van Rensselaer
Pearse, Langdon
Pillsbury, Charles Lucien
Poe, Harry Tinker, Jr.
Poorman, Alfred Peter
Popert, William Hopf
Post, Chester Leroy
Powelson, Wilfrid Van Nest
Price, Philip Wallis
Pugh, DeWitt Pawling
Ray, George Joseph
Ripley, Blair
Ripley, Herbert Lawrence
Rippey, Samuel Howard
Robertson, David
Robinson, Erdis
Robinson, Reuben Totman
Rohrbough, Elmore Marcellus
Rowe, Walter Ellsworth
Sadler, Carl Leon
Safford, Harry Robinson
Sawyer, George Loyal
Scrimshaw, James Frederick
Seabury, George Tilley
Sloan, William Griffith
Smith, Walter Townsend
Spelman, John Rodgers
Stanley, Orrin Elmore
Steers, Anthony Enoch
Stevens, John Cyprian
Steward, Harry Matthew
Stilson, Minott Augur Osborn
Stockton, Robert Summers
Strong, Archibald McClure
Talbot, Earle
Theodorson, William Anton
Thomas, Charles Dura
Thomas, Ralph Danford
Trimble, Roswell Delmege
Turner, Augustus Miesse
Turner, Franklin Pierce
Upson, Maxwell Mayhew
Valle Zeno, Carlos del
Van Liew, John Edgar
Van Suetendael, Achille Octave
Varney, William Wesley
Vaughan, John Fairfield
Waltman, William DeWitt
Wenige, Arthur Emil
Wilson, Wilbur Thomas
Winsor, George Alpha
Woodward, Sherman Melville
Yates, William Henry
Zimmermann, Walter Gustaf

Founder's Day Services at V.M.I., Honor Memory of Col. Claudius Crozet

At Founder's Day exercises, held November 11 on the grounds of Virginia Military Institute, the 103d Anniversary of the establishment of the Institute at Lexington, Va., was celebrated. The ceremonies honored the memory of Col. Claudius Crozet, first president of the Board of Visitors, whose remains were re-interred at a prominent site on the grounds.

The tribute to Colonel Crozet, sponsored by the Virginia Section of the Society, was delivered by Col. William Couper, V.M.I. historiographer, who has prepared a biography of Crozet. The following extracts from the address will show the vision and courage which marked the career of this former Chief Engineer of the State of Virginia.



Only Known Existing Portrait of Colonel Crozet

"The word 'war' looms large in Crozet's career. It was during the French Revolution, a few months after the fall of the Bastille, that a little boy was born at Villefranche, near Lyons, France. He was christened Benoit Crozet. During the Revolution the schools of France, from the university down, were destroyed, and when young Crozet was in his fifth year, a new educational institution was established in Paris as a protest against the tradition of devoting effort in places of higher learning almost exclusively to literary and abstract studies. It was the great Polytechnic School. Later Benoit Crozet was graduated from this institution.

"He then went to Metz, where the School of Artillery and Engineering was located, and after studying there for two years, he entered upon his military career just in time to join the Emperor Napoleon's Army and take part in the Battle of Wagram, which was fought less than a month after his graduation. A short time before this, Crozet dropped the 'Benoit' and adopted 'Claudius' as his Christian name, perhaps following a custom used by the citizens of France after the French Revolution in which they dropped their given names and adopted those of well-known Romans.

"His military career was divided between the engineer and the artillery services, but it was as an artilleryman that he was captured during the disastrous Russian campaign, and not until Napoleon's abdication was he released, only to rejoin the colors when the Emperor returned from Elba.

"After the Waterloo campaign, in which Crozet took part, he felt that there was no future for a young soldier in France, and so he emigrated to the United States. . . . He was first engaged at the United States Military Academy as a professor. There had been one professor of engineering at West Point ahead of Crozet. He was Colonel Partridge and he had been the titular professor of engineering for three years, but he never practiced the profession. The Academy was at a very low ebb and there was not a single graduate in the Class of 1816. And so it was Crozet's good fortune, in the reorganization of the Academy, which took place at that time, to start from scratch and to place the study of engineering on the high plane which it later enjoyed.

"Circumstances of health induced Crozet to seek a warmer climate and after unsuccessfully trying to get a position at the University of Virginia, then being born, he became the Chief Engineer of Virginia—a title which varied from time to time. It was the period of turnpike and canal building, and if you would have some idea of his vision, as you ride along Route 60, look at the Slate River, just west of Buckingham Courthouse, and see what he made navigable. The canal was the only means of conveying bulk commodities to that community, which is illustrative of many such communities. The turnpikes, or highways, which he developed, although small compared with our modern machine-made arteries, were located with that rare vision which has caused them to remain substantially as laid out, and it was his privilege to lay down the Virginia and West Virginia sections of three of our few transcontinental highways.

"He visualized the replacement of the canals by the railroads and in pressing this innovation, which was having some success in England, he ran afoul of powerful influences in the State which were committed to the canal and they promptly legislated him out of office, with the result that he left Virginia and soon was following similar occupations in Louisiana. Working from that end he continued his plan of projecting a railroad connecting the National Capital with the Mississippi, and in the course of time he beheld its realization. While in Louisiana he again engaged in educational work as the president of Jefferson College, later considered as one of the proposed sites of Louisiana State University. . . .

V.M.I. Corps Drawn Up Facing Preston Library
Platoon in Foreground Fired Three Volleys Over Colonel Crozet's New Grave

"Once Crozet had left Virginia, some of those in authority began to realize what the State had lost and so, five years later, he was recalled to resume his position as Chief Engineer of the State. Within a few weeks he was appointed a member of a board to consider the establishment of an educational institution at the Lexington Arsenal. The board elected him its presiding officer; he so continued for the next eight years; and it was under the guidance of the boards over which he presided that the Virginia Military Institute was founded on the 11th of November, 103 years ago. And so this recent national holiday has always been a holiday at V.M.I.—it is its birthday. Colonel Crozet wrote the regulations under which the Institute operated and under which, to a considerable extent, it still operates. . . .

"We will mention one other example of his vision. It is the great artery of travel which enables trains to overcome the Blue Ridge Mountain barrier. There was no construction machinery, as we know construction machinery, when this pioneer series of railroad tunnels was built, and eight years of labor were consumed before trains could use them, but so well had the problem been solved that today, 93 years after the tunnels were designed, they carry traffic pulled by enormous locomotives far beyond the dreams of Crozet. But are they so far beyond his dreams? Crozet designed the tunnels, he supervised their construction, and they are still in use, although within a year a new one will probably supplement those now in operation. . . .

"And so we have him as a man among men, one who had the courage of his convictions, who disliked personal publicity, and who had the vision to found worthy things which have continued to live and be of service to humanity."

President Black's Visits

DOVETAILING his plans in with a very strenuous construction season, President Black has found it possible to make some long-deferred trips to visit Local Sections during the late fall and early winter. During November he attended the annual meeting of the Iowa Section in Des Moines on the tenth, and met with the Tri-City Section at Rock Island on the eleventh.

During December he made a visit to Purdue University on the eighth and spent the day in East Lansing, Mich., on December 11, with Lansing members and students from Michigan State College. The following day, December 12, he divided between the Student Chapter of the University of Michigan, at Ann Arbor, and the members of the Michigan Section, as well as the students of the University of Detroit, in Detroit. The Society's Executive Committee, over which Mr. Black presides, met in New York on Sunday, December 13.

Later in December, or early in January, he has held in prospect a trip to Local Sections and Student Chapters along the west coast. It will depend on circumstances whether or not he can carry out those plans. During wartime the usual tours made by the Society's President are of necessity curtailed. For this reason, all those that he is able to make are especially appreciated by the Local Sections and Student Chapters concerned—not to mention the fact that they are also enjoyable for President Black.

Openings with Aviation Engineers, U.S. Army

RECENT developments in the engineering organization for the construction of Army air bases are noted in some detail in the article in this issue by Brig. Gen. Stuart C. Godfrey (page 7). Establishment of these forces is now progressing rapidly.

Supplementing General Godfrey's article, it will be of interest to members to know that commissions in the Aviation Engineers are now being considered by the Chief of Engineers, U.S. Army. Age limits are stated to be 35 to 45; and the draft status should be in classifications other than 1A, 1B, or 4F. It is expected that commissions will be limited to Captain, First Lieutenant, and Second Lieutenant.

Detailed notices of these opportunities have gone to the Society's Local Sections. Members who are interested may therefore address inquiries to the secretary of their local group, or to

Engineer Section, Base Services
Headquarters, Army Air Forces
Washington, D.C.

News of Local Sections

Scheduled Meetings

CENTRAL OHIO SECTION—Luncheon meeting at the Fort Hayes Hotel on January 21, at 12 m.

CLEVELAND SECTION—Annual Meeting at the Guildhall Restaurant on January 8, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the University Club on January 11, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on January 18, at 12:15 p.m.

DISTRICT OF COLUMBIA SECTION—Dinner meeting at the Washington Hotel on January 28, at 6:30 p.m.

ILLINOIS SECTION—Luncheon meeting at the Chicago Engineers' Club on January 22, at 12:15 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on January 13, at 6:15 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on January 13, at 8 p.m.; regular meetings of the Junior Branch in the Engineering Societies Building on January 13 and 27, at 7:30 p.m.

MIAMI SECTION—Dinner meeting at the Seven Seas Restaurant on January 7, at 7 p.m.

NORTHEASTERN SECTION—Dinner meeting at the Engineers' Club on January 25, at 6 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Minnesota Union on January 4, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on January 12, at 6:30 p.m.—meeting at 7:30 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on January 25, at 12:15 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum at the Engineers' Club on January 28, at 6:30 p.m.

SEATTLE SECTION—Business meeting at the Engineers' Club on January 25, at 8 p.m.

SOUTH CAROLINA SECTION—Annual luncheon meeting at the Columbia Hotel, Columbia, on January 8, at 12 m. (Joint session with the South Carolina Society of Engineers.)

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on January 4, at 12:10 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on January 11, at 12:15 p.m.

Recent Activities

CENTRAL OHIO SECTION

At a luncheon meeting held on November 19 Albert Prebus, assistant professor of electrical engineering at Ohio State University, was the speaker. Dr. Prebus gave an illustrated lecture on the electron microscope—what it is and how it can be used. On December 1 there was a joint dinner meeting with the Ohio State University Student Chapter. Following the presentation of certificates of life membership to H. D. Bruning and Erdis Robinson, Felix Held spoke on the topic, "Sense and Nonsense." Mr. Held, who is secretary of the college of commerce and administration at the university, used the subject to emphasize what he considers three important requirements for success.

CLEVELAND SECTION

Problems confronted in operating a municipal transportation system in wartime were discussed at the November meeting of the Section. The speaker was Walter J. McCarter, commissioner of

transportation for the city of Cleveland. To meet the transportation requirements of industrial areas and the traffic problems caused by gasoline rationing, the city has ordered 60 trailer buses. The trailers will seat 28 and will take care of 14 more, standing. Another plan under discussion to help solve the transportation problem is for the use of small trailers of ten-passenger capacity to be pulled by privately owned automobiles.

The speaker of the day at the December meeting was Comdr. J. S. Leister, of the U.S. Naval Reserve, whose subject was "Facts Pertaining to the Civil Engineering Corps of the Navy." Commander Leister pointed out that little is known of the vast shore establishments that are necessary to keep a great fleet on the high seas. He then described the role of the construction battalions of the Navy in the building of these shore establishments, emphasizing the need for more engineers for officers for this construction corps, popularly known as the Seabees.

Colorado Section

A symposium on the Rocky Mountain Arsenal was the feature of the November meeting of the Colorado Section. The first speaker was R. F. Graef, project engineer for Whitman, Requardt and Smith, engineer-architects on the project, who discussed the problems arising during construction of the arsenal. Next Col. Charles E. Loucks, commanding officer of the Chemical Warfare Service, explained the different features of chemical warfare and the role of the arsenal in military production. A talk by Lt. Col. Harry R. Kadlec, area engineer for the U.S. Corps of Engineers in charge of constructing the arsenal, concluded the program. Colonel Kadlec outlined the military aspects of construction and discussed the difficulties of wartime construction in general.

Economy Despite High Taxes

The prevailing high Federal income tax rates have at least one economical angle—that of lowering the effective cost of Society membership by at least 20%.

This is brought about by the fact that even on the lowest taxable incomes each dollar is taxable at the rate of 19%—with a progressively higher rate in the upper brackets.

Thus the deduction of Society dues, say twenty dollars, has the practical effect of lowering the tax to be paid by almost four dollars—the saving being proportionately larger on higher incomes. Since Society dues are a proper deduction from taxable income, and since all of us pay income taxes, this is one saving we can all take advantage of, thereby easing and encouraging our continued financial support of the Society through the present period of emergency.

Connecticut Section

The principal speaker at the November meeting of the Connecticut Section was A. L. MacClain, chief test pilot of the Pratt and Whitney Division of the United Aircraft Corporation. Mr. MacClain spoke on flight testing, describing the various engineering data revealed by the tests, the methods of making tests, and in a general way the use to which the tests will be put in improving air-cooled aircraft engines. He also discussed some of the difficulties involved in night flying and instrument flying.

District of Columbia Section

At the annual business meeting of the Section, which was held in November, the following new officers were elected: Harold H. Marsh, president; Roy W. Crum, vice-president; Benjamin E. Jones, secretary; and Frank L. Weaver, treasurer. The guests of honor and principal speakers were President-elect Ezra B. Whitman and Secretary Seabury. Both discussed the organization of bargaining agencies among engineers, Mr. Seabury describing the findings of Howard F. Peckworth in this connection.

There was a turnout of over 500 for the December meeting of the Section, which was held jointly with local groups of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. A timely talk on "Material Conservation and Production Problems in the War Effort" was given by Brig. Gen. W. H. Harrison. There were also short talks by representatives of the participating groups, the speaker for the Society being Past-President Hammond.

Florida Section

On November 3 the Florida Section held a joint dinner meeting at Jacksonville with the Engineering Professional Club of Jacksonville. The feature of the occasion was a talk on the development of the airplane. This was given by Professor Eastwood, head of the engineering mechanics department of the University of Washington. Professor Eastwood showed slides of the wind tunnel in use at the University of Washington for testing airplanes. Almost all the planes in use today, he pointed out, are modifications of the ones built a year ago. The need for change and development is proved in the laboratory before the actual test flight takes place. Professor Eastwood also showed and explained diagrams of a method of measuring pressures on different parts of plane models being tested by a method devised by his department. The method involves a scale beam that reflects a beam of light on an electric eye tube, which regulates the amount of current to a coil that balances the beam of the scale, thereby measuring the pressure.

Iowa Section

Members of the Iowa Section met at Des Moines on November 10 for afternoon and evening sessions. At the business meeting held in the afternoon the following officers were elected for the coming year: Raymond R. Zack, president; L. C. Crawford, vice-president; and L. O. Stewart, secretary-treasurer. The technical program at this session consisted of a talk by O. W. Crowley on the construction of the Alaskan Highway. Mr. Crowley, who is executive secretary of the Associated General Contractors of America, with headquarters at Des Moines, served as coordinator on that project. The dinner meeting that evening was addressed by E. B. Black, President of the Society. During the evening T. R. Agg, newly elected Vice-President from Zone III, was introduced to the membership, and a certificate of life membership was presented to J. E. Van Liew. Ross Coomer, the other recipient of a certificate of life membership, was unable to be present.

Kansas City Section

Aspects of civilian defense were discussed at the November meeting of the Kansas City Section. The first speaker was L. P. Cookingham, city manager, who described the local organization in charge of civilian defense and commented on their praiseworthy achievements. He said that 55,000 have registered for the defense work, and that 50,000 have taken the requisite training for this work. A. C. Everham then discussed organizations within the city government to facilitate defense work. He appealed to the Section for assistance in the selection of "Incident Officers," pointing out that engineers, by reason of their training, are best qualified to serve in this capacity.

Louisiana Section

At the November meeting of the Louisiana Section J. T. L. McNew, Director of the Society, discussed the aims and objectives of the Society, emphasizing particularly its wartime role. His comments touched on Student Chapter development, increasing the membership, the unionization of engineers, establishment of adequate fees, and fair compensation for employed engineers. Mr. McNew also discussed the Baird-Snyder Schedule of Lump Sum Fees to be paid engineers for professional services on war public works construction. During the business meeting a certificate of life membership was presented to F. Petrie Hamilton. Recipients in absentia were John Lindhé and Jacob T. Bullen.

Maryland Section

At the meeting held on December 8 Ezra B. Whitman, nominee for President of the Society, was present and spoke briefly. During the business meeting the following officers were elected for next year: Paul L. Holland, president; Edward W. Digges, vice-president; and Paul A. Cohen, secretary-treasurer. A talk on sanitary engineering conditions in Latin America comprised the technical program. This was given by Abel Wolman, professor of civil and sanitary engineering at the Johns Hopkins University. In August of this year Dr. Wolman was sent by the State Department to South America, where he met representatives of the Latin-American countries to discuss sanitation and public health problems related to war activities and to post-war planning. He recently returned to Baltimore after traveling nearly 30,000 miles by plane. He discussed some of his experiences during this trip and commented on conditions in Latin America. The theme of his talk was the great

need for modern sanitary methods and facilities in a large part of South America, including even the metropolitan areas.

Metropolitan Section

A paper on "Contracting Procedure Under Present Government Regulations" was read at the November meeting of the Metropolitan Section. The paper was prepared by J. Wright Taussig, vice-president of the Raymond Concrete Pile Company, who has reviewed some 400 contracts during the past two years. Due to Mr. Taussig's illness, the paper was presented by his associate, J. L. Nalen. The paper described the various forms of contracts currently in use and pointed out details that must be attended to if many annoying and costly contract difficulties are to be avoided.

Mohawk-Hudson Section

On October 28 Bernard Gray, chief engineer of the Asphalt Institute, addressed a meeting of the Mohawk-Hudson Section on the subject of developments in the design of airports. Mr. Gray emphasized the stability of the paved surfaces used for landing strips. Of special interest was the speaker's discussion of the use of local materials to bring about the required stability in subgrade and surface to support the increased traffic of military airports. The talk was illustrated. Guests of the Section for the occasion included members of the Rensselaer Polytechnic Institute Chapter and a class in highway and airport design now in progress at the Institute.

Mid-South Section

The annual meeting of the Mid-South Section, which was held in Little Rock, Ark., on November 14, took the form of an all-day session. Speakers at the morning meeting were J. M. Page, senior highway engineer for the Public Roads Administration, whose subject was "Military Roads and Roads for National Defense," and R. E. Wardeu, engineer of public improvements for the Missouri Pacific Railroad, who discussed the railroad's part in the war effort. Following general discussion of these two papers, the group adjourned for luncheon with the Little Rock Engineers' Club. In the afternoon L. L. Hidinger, president of the Morgan Engineering Company, displayed a film and spoke on the subject, "The Tennessee Valley Authority from Peacetime Activities to Wartime Production." Earl Grochau, construction engineer for the Memphis Construction Company, then discussed construction costs. Election of officers for the coming year concluded the program. These are John M. Page, president; Lee H. Johnson, Jr., vice-president; and Alfred E. Johnson, secretary-treasurer.

Texas Section

Because of the war the fall meeting of the Texas Section was streamlined to a certain extent. Members met in Houston Thursday night, November 5, for the first of the sessions. The technical program that evening consisted of a lecture and film on the failure of the Tacoma Narrows Bridge, the lecturer being A. A. Jakkula, professor of structural engineering at the Agricultural and Mechanical College of Texas. The rest of the evening was devoted to dancing and social get-togethers. The usual breakfast for students was held Friday morning instead of Saturday, as in the past. The student representation was very good, totaling 53. John H. Bringhurst, chief engineer of the American Republics Corporation,

TEXAS MEMBERS OF THE SOCIETY GATHER FOR THEIR FALL MEETING
Left to Right: L. R. Ferguson, S. W. Oberg, W. S. Bellows, Gus Bracher, H. F. Anthony, and E. N. Noyes

A BANQUET CONCLUDED THE FALL MEETING OF THE TEXAS SECTION
Reading Left to Right: S. Y. Wong, H. R. Safford, and E. C. Woodward

was the toastmaster. The Friday morning technical session was called to order by E. C. Woodward, president of the Texas Section. After an exchange of amenities by H. G. Dibbrell, assistant city attorney, and J. T. L. McNew, Society Director, a paper on the Harris County Drainage District was presented. This was given by Col. H. R. Norman, of the U.S. Engineer Office at Galveston. The next speaker was J. M. Nagle, consulting engineer for the Harris County Drainage District, who described the machinery used in the construction of Barker Dam—one of the projects for the control of floods in the Houston area. In the absence of the third scheduled speaker—R. J. Cummins, Houston consultant, who was detained by illness—R. R. Lewis, attorney for the Harris County Drainage District, spoke briefly. A paper on the wartime use of wood in structural work, presented by Prof. Howard Hansen, concluded the session.

At the noon luncheon the principal speaker was S. Y. Wong, a Chinese engineer, who is in the United States making a special study of oil pipelines and related equipment. Mr. Wong discussed wartime conditions in China from an engineer's point of view. An illustrated lecture on camouflage—by Prof. Sophus Thompson, who has been engaged in engineer training work at Fort Belvoir—concluded the technical session. The rest of the afternoon was devoted to a business meeting, during which officers for 1943 were elected. These are John H. Bringhurst, president; and James P. Exum and O. V. Adams, vice-presidents. An excellent floor show and magician's performance added to the enjoyment of the banquet that evening.

Philadelphia Section

A symposium on "Cooperation of Water Supplies for Defense" was presented at the November meeting of the Section. The first speaker was H. Lloyd Nelson, Eastern sales manager of the U.S. Pipe and Foundry Company, who discussed the general problems involved in the interconnection and cooperation of water supplies, and how the problem is affected by priorities. Then Howard T. Critchlow, engineer in charge of the New Jersey State Water Policy Commission, spoke on what New Jersey is doing as regards the interconnection and cooperation of supplies. Mr. Critchlow showed large maps illustrating the system that has been organized in the state. Next Howard E. Moses, chief engineer for the Pennsylvania State Department of Health, showed on a chart the Pennsylvania systems that have been interconnected. He also indicated the points where it would be possible to make other interconnections. A talk by Harry Freeburn, chief engineer of the Philadelphia Suburban Water Company, concluded the program. Mr. Freeburn, who was acting chairman of the evening, discussed the arrangements that have been made in the Philadelphia metropolitan area. Following a general discussion, two films were shown through the courtesy of the U.S. Pipe and Foundry Company.

North Carolina Section

The fall meeting of the Section took place in Durham on November 3. The afternoon session began with the presentation of a paper on "State Coordinate System of Maps." This was given

by T. S. Johnson, professor of sanitary engineering at North Carolina State College, who dealt largely with the historical aspects of the subject. Next Professor Louise Hall, of Duke University, discussed the timely subject of how Duke is training women students in drawing and cartography to take their place in engineering for the duration. The university began admitting women to the school last winter, when it became evident that there would be a great need for more engineering help. Glenn Martin was the first to apply to Duke for women employees, and now thirty government bureaus need their help for mapping work. The final paper of the session was presented by W. M. Piatt, consulting engineer of Durham, whose subject was "Code of Professional Ethics as Developed by Engineering Council for Professional Conduct." The meeting was then turned over to the North Carolina State and Duke Student Chapters, with Richard J. Lynch, of the Duke Chapter, presiding. The evening meeting convened with the North Carolina sections of the American Water Works Association and the American Sewage Works Association. A talk by H. E. Jordan, secretary of the American Water Works Association, comprised the technical program. The evening ended with a dance.

Members Under Arms Profit by Special Society Privileges

Many younger Society members in the armed services are now entitled to special considerations in the matter of dues. For those who may have missed the previous announcement, a repetition of the action of the Board of Direction at its October meeting is given as follows:

"Cancellation of 1943 dues is hereby extended automatically to all those members of the Society in the armed services of the United States who are Selectees; and, upon request for such cancellation, to those commissioned officers receiving base pay of $2,400 or less. Those who receive this exemption will continue to be listed as members of the Society and have prior unpaid dues canceled; and those who are Corporate Members shall retain their voting rights. However, no publications except Civil Engineering are to be forwarded to those thus exempted."

Sacramento Section

Speakers at the November luncheon meetings of the Section were Eric Marx, of the American Molding Company, who discussed plastic molding; Maj. Ernie Smith, traffic manager for T.W.A. Airlines, whose subject was "Trans-Pacific Aviation, Past and Future"; and Roy McClure, manager of the B. F. Goodrich Company, who presented a program on the subject of synthetic rubber production. On the latter occasion a sound reel, entitled "Keep 'Em Rolling," gave a résumé of the history of automotive transport and of the advances in automotive engineering and tire design. There was also an actual demonstration of producing "Amerpol" from its ingredients of petroleum, liquid soap, gas, air, and water, followed by a discussion of the process and the possibility of production on a commercial basis.

Tacoma Section

On November 17 members of the Tacoma Section met in Olympia for dinner and a technical session. The speakers of the evening were C. H. Williams and C. M. Kirsap. Mr. Williams, who is city engineer and water superintendent of Olympia, discussed the many and varied problems encountered in the maintenance and modernization of the Olympia water system, while Mr. Kirsap spoke on his experiences in connection with making Olympia the best dimmed-out city in the Puget Sound area. The question of the effect of gasoline rationing on the monthly meetings was generally discussed, though no conclusions were reached.

Tennessee Valley Section

The annual meeting of the Tennesee Valley Section took place in Chattanooga on November 7. Numerous business matters were discussed at the morning session, and the annual election of officers was held. The new officers are Felix Truss, president; H. F. Finck, vice-president for the Asheville Sub-Section; Arthur W. Crouch, vice-president for the Chattanooga Sub-Section; and George P. Palo, vice-president for the Knoxville Sub-Section. Following the election, Howard F. Peckworth was introduced and spoke on the Society's work in the investigation of employment conditions. At the noon luncheon E. M. Hastings, newly elected Vice-President of the Society, spoke on the subject of international problems, emphasizing the importance of character in planning the post-war world. The afternoon session consisted of five short talks on the problems of manpower in the war. First N. W. Dougherty, dean of engineering at the University of Tennessee, discussed the effect of the war on the universities. The industrial training that has been carried out in Chattanooga during the past year was described by Ray W. Evans, secretary of the Chattanooga Industrial Y.M.C.A., while Charles Parsons, of the Chattanooga Vocational High School, discussed the work of his organization in training men and women for war jobs. Charles E. Nichols then described the problems of present-day living in Washington, and a discussion on the work of engineers in the Navy concluded the program. The latter talk was given by Lt. A. B. Pittman, Jr., of the Office of Naval Officer Procurement of Nashville. The meeting closed with a brief talk by presiding officer Charles W. Okey, who congratulated the Chattanooga Sub-Section on its part in making the affair a success.

Toledo Section

An appeal for applicants for the Civil Engineering Corps of the U.S. Navy was made by Comdr. J. S. Leister at the annual banquet of the Section, which took place on December 2. Commander Leister explained the requirements and qualifications necessary for enlistment, and said that only 15% of the number of men needed in this service had been enlisted. The annual election of officers, held at this time, resulted in the selection of the following: Russell W. Abbott, president; William Sanzenbacher, vice-president; and Robert Brown, secretary-treasurer. L. M. Friedrich will continue as vice-president.

Tri-City Section

On November 11 President Black and Vice-President C. B. Burdick were guests of the Section for its annual meeting. After several vocal selections by the Augustana Men's Quartet, there was a brief business meeting, during which new officers were elected. These are F. L. Flynt, president; W. L. Porter, vice-president; and E. J. Snow, secretary-treasurer. The visiting officers then discussed the Society's war effort. Mr. Burdick spoke particularly of the handicaps suffered at Society Headquarters by members of the staff entering the armed forces. President Black then discussed the role of the Society in war and post-war planning, emphasizing the fact that construction will soon be over and that production will then get into full swing.

West Virginia Section

Speakers at the November dinner meeting of the West Virginia Section were Col. W. B. Higgins, district engineer for the U.S. Engineer Office at Huntington, W. Va., and R. E. McCurdy, resident engineer for E. B. Badger and Sons Company, of Boston, Mass. Colonel Higgins discussed the activities of the Corps of Engineers in the current war production program, while Mr. McCurdy's subject was "Functions and Problems of the Architect-Engineer in Wartime Construction." During the evening a certificate of life membership was presented to George H. Hill.

Appointments of Society Representatives

Robert V. Labarre and Lazarus White, Members Am. Soc. C.E., have been appointed Society representatives on the Sectional Committee of the American Standards Association on Building Code Requirements for Excavation and Foundations, to fill the vacancies caused by the death of H. J. Deutschbein and the resignation of Col. Carlton S. Proctor.

Jonathan E. Teal, M. Am. Soc. C.E., has been appointed to the Executive Committee of the Engineering Economics Division for the term ending in 1947. He will take the place of incoming Vice-President E. M. Hastings, who is to retire from the Executive Committee of the Division in accordance with the custom of relieving incoming members of the Board from all committee appointments.

Ralph Whitman, M. Am. Soc. C.E., has been appointed to the Executive Committee of the Waterways Division for the term ending in 1944. He will take the place of incoming Director R. E. Bakenhus.

ITEMS OF INTEREST

About Engineers and Engineering

Civil Engineering for February

As increased attention has been directed towards the rise of timber as a durable structural material, fabricators of wooden trusses and laminated glued arches and beams have been hard pressed to keep up with the demand. Because of the intensive study that has been given to glues and improved fabricating shop processes, many man-hours have been saved in preparing timber for structural use. The methods developed by his firm will be described by Verne Ketchum, of the Timber Engineering Company, in the February issue. Of special interest is his analysis of the relative efficiency of various types of joints used in glued laminated fabrication.

Heavy traffic of Army equipment, especially track-laying vehicles, destroys a low-grade highway surface in short order. Thus in the construction of cantonments special attention must be given to the preparation, with available materials, of a low-cost surface that will require a minimum of maintenance. "Soldiers have so much to do that they can't keep patching up the roads" is commonly heard. The construction of countless miles of these military roads in connection with cantonment projects in the West has provided Don Hull McCreery with the material he has used in his article in the forthcoming issue.

Even as the ground forces of our motorized army face the problem of roadway surfaces, so the air forces face a somewhat similar problem in securing a sufficient number of conveniently located landing fields. In many localities where it has been possible to use one landing runway, "flight strips" have been quickly constructed—generally near a highway which can make the strip readily accessible. A Flight Strips Division of the Public Roads Administration has been created to supervise this work, with Fred E. Schnepfe as director. His forthcoming article discusses the salient features of several types of construction being used for these "flight strips."

Revised Arbitration Rules Are Issued

Engineers are among the leading exponents of arbitration as a means of settling disputes. They have sponsored such procedure and often have served on arbitration panels. Very frequently in such cases it is necessary to refer to the rules of the American Arbitration Association.

It is therefore of interest that the Association has just issued a revised edition of its Voluntary Labor Arbitration Rules of Procedure, to meet war regulations and conditions. The Rules are accompanied by a Manual for using them, covering such important subjects as: Panels of Arbitrators; Summary of Procedure with Respect to Parties, Arbitrators and the Association; Institution of Proceedings; Appointment of Arbitrators; Hearings and Awards. A special section on the arbitration of wage disputes is included, which contains procedure for referring wage decisions to the National War Labor Board for review, and directions for expediting proceedings under its Rules, in relation to policies set forth by the War Labor Board.

A complete index enables those using the Rules and the Manual to find immediately the pertinent regulation or instruction needed in a proceeding. The Rules have been formulated by the joint effort of management and labor, and reflect the experience of the Association in more than a thousand labor arbitrations.

The Rules and Manual are available on request to the American Arbitration Association, 9 Rockefeller Plaza, New York, N.Y.

N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

"Nothing like having a Guest Professoress now and then so that I can enjoy a little kibitzing. Ann, the Far Hop Bridge is all yours."

"My pleasure, Noah, for I'm a matchmaker at heart. Altho one of General Tu's daughters eloped, the others are still waiting for smart husbands. So who can tell the maximum possible intensities of tension and shear in the 6 by 6-ft granite girders when the 18-ton Waltzing Matilda is standing on the bridge."

"It's a nice problem," said Cal Klater, "involving a maximum with two variables. After two nights of calculus, I placed Matilda's back 13.546 ft $[=(6457 + 20\sqrt{465{,}297})/1369]$ from one support and found a moment of 1,146,100 ft-lb at 18.085 ft $[=(182{,}961 + 25\sqrt{365{,}297})/10{,}952]$ from the other. Maximum tension at the bottom of the girder would be 221.085 lb per sq in.

"Maximum shear is relatively simple. Obviously Matilda's back must be at the abutment, making the near reaction 31 (live) plus 97.2 (dead) = 128.2 kips. Maximum intensity will be 37.095 lb per sq in., or 50% greater than mean shear for the section, and will occur at Point *A* in this sketch."

"No Tu sisters for you, Cal, in spite of the brilliant mathematics," was Professor Othernut's verdict.

"Cal is right on the tension," said another, "but the shear intensity should be multiplied by Timoshenko's coefficient of 1.126, making it 41.8 lb. per sq in. But I'm married and don't want the prize."

"Sour grapes," exclaimed Ann. "You've all overlooked two things. Matilda was to be standing, not waltzing, and she can stand on her hind grousers, as in this lower sketch. So the problem is simple, giving 231.25 lb per sq in. for the maximum tension.

"Maximum horizontal or vertical shear was not asked for. Diagonal shear will be a maximum at top and bottom of girder under the load, amounting to half the tension, or 115.625 lb per sq in. So we'll hold the prizes for some other contest. I'll bet I had you fooled too, Noah!"

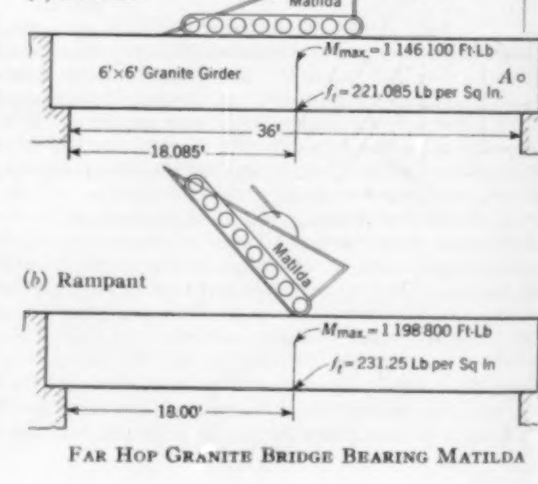
"Maybe, but I'm professionally evasive. Anyway, I admire the way you left the experts spellbound. I'll try to regain their confidence with a new and easy problem, sent me by Count de Myles.

"Looking over the rubber on his Prewar Six sedan, he estimated that the right rear tire would run 11,000 miles; the left rear, 10,000; the right front, 9,000; and the left front, 8,000. Estimating the spare was complicated, as he had read that wear on the four wheels varied as 38:29:19:14, respectively, but he rated it for 6,993 miles if used on the left front.

"On how many miles can Count de Myles count before his sedan must be retired (one way or another)?"

[*As acknowledged in November, Guest Professoress Ann Othernut is J. Charles Rathbun. Expert mathematicians Cal Klater were Richard Jenny, Claude W. West, John C. Prior, and O'Kay (Otto H. S. Koch).*]

For an interesting example of an historic stone girder bridge, see Professor Rathbun's story elsewhere in this section.



Far Hop Granite Bridge Bearing Matilda

Army and Navy "E" Awards to Contractors

For outstanding performance of contracts, awards of the Army and Navy "E" have been made to general contractors on ten important Army, Navy, and industrial construction projects.

Following is the list, as released by the Public Relations Press Section, Washington, D.C., of the contractors whose work has been signally recognized: Contractors, Pacific Air Bases, Pearl Harbor, T.H. (for list of individual contractors see December issue, page 710); Brann and Stuart, Mechanicsburg, Pa.; Doyle and Russell, Norfolk, Va.; Maxon Construction Company, Inc., Burns City, Ind.; Macco Construction Company, San Diego, Calif.; P. T. Cox Construction Co., and Spearin, Preston and Burrows, Inc., Newport, R.I.; Wigton-Abbott Corporation and Mahony-Troast Construction Company, Inc., Bayonne, N.J.; Virginia Engineering Co., Inc., Norfolk, Va.; Dunn Construction Co., and Polk Smartt Paving Co., Millington, Tenn.; and Barrett and Hilp, Mare Island, Calif.

Awards have not thus far been made to architects and engineers for their professional services. The reason is that the Army and Navy "E" is designed primarily as a production award.

A.S.A. Announces Inter-American Program

In the program of cooperation with South American countries, recently announced, the American Standards Association is seeking to promote similar standards for engineering and industry throughout the Western Hemisphere.

Full-fledged national standardizing bodies are now in operation in three South American countries. The one in Argentina (Instituto Argentino de Racionalización de Materiales) has been operating a number of years and publishes a monthly magazine. The one in Brazil (Associação Brasileira de Normas Técnicas) has recently issued a volume of standards. The one in Uruguay (Instituto Uruguayo de Normas Técnicas) was formed a short time ago. In other Latin American countries there are government departments and engineering societies doing similar work. Furthermore, there is a South American committee (Comité Sudamericano de Normas) to further standardization work in the ten South American republics.

In the program, the A.S.A. will exchange technical data in the development and use of standards with the other American republics, give them information on the standardization work being done in the United States, as well as provide them with Spanish and Portuguese translations of standards which would be especially valuable in developing their industry.

A prime object of the program is to provide so thorough an interchange of technical data and information that, as a result, all the countries of the Western Hemisphere will have standards as much alike as possible.

Latin American countries have already shown a great deal of interest in the standards of North America, and this has been strengthened by recent international developments. The A.S.A., with a large membership of professional societies, including the American Society of Civil Engineers, recognizes this trend. It will cooperate wherever possible in furnishing the standards that have been established, from its headquarters at 29 West 39th Street, New York, N.Y.

Lincoln Foundation Awards For Engineering Students

The James F. Lincoln Arc Welding Foundation, of Cleveland, Ohio, has announced its first award program in the field of undergraduate engineering study. By the provisions of this program, $6,750 will be given annually in the form of awards and scholarships. Of this amount, $5,000 is offered in student awards and $1,750 in scholarships for the institutions in which the prize-winning students are registered.

Resident engineering undergraduates in any school, college, or university in the United States, which gives a course in any branch of engineering or architecture leading to a degree, are eligible to submit a paper in the award program. Cadets registered in the U.S. Military Academy, the U.S. Naval Academy, and the Coast Guard Academy are also eligible.

The awards will be made for papers describing the conversion from other methods to arc-welded construction of parts of machines, complete machines, trusses, girders, or structural parts. Subjects range from the student's observations from school shop work, or from magazines, books, printed matter, or other material to original ideas that could be put into practice by arc welding. The Foundation encourages the preparation of the type of paper that will not interfere seriously with the student's regular college activities.

Further details of the program may be obtained by writing The James F. Lincoln Arc Welding Foundation, P. O. Box 5728, Cleveland, Ohio.

War Manpower Recommendations of Consultative Committee on Engineering

That the War Manpower Commission undertake immediately, with the cooperation of the War Production Board, a factual survey of shortages of professional engineering manpower in war industries has been recommended by the Consultative Committee on Engineering for the Professional and Technical Division of the War Manpower Commission.

Formed at the request of Dr. E. C. Elliott, of the War Manpower Commission, this committee has brought together representatives of each of the professional societies. This their latest action has taken full cognizance of the last reorganization of the War Manpower Commission.

At the same time the committee made the following recommendation:

"Recognizing the necessity for a continuing flow of professionally trained men for war industries, especially for urgent developmental work in improving the quality and production of actual weapons and materials of warfare, this Consultative Committee on Engineering for the Professional and Technical Division of the War Manpower Commission, respectfully recommends that the Chairman of the War Manpower Commission immediately take the necessary steps in order to provide temporary deferment from military service for those undergraduates in recognized engineering schools who are subject to Selective Service. Such deferment is necessary pending a more thorough study of the requirements of engineering manpower both by war industries and the Armed Forces.

"This recommendation confirms and re-emphasizes the resolutions made by the recent annual meetings of the American Society of Mechanical Engineers, the American Institute of Chemical Engineers, the Society for the Promotion of Engineering Education, and others, looking to the deferment of those young men who are already in engineering training and are maintaining satisfactory academic records. This is not a recommendation for class deferment, but is a recognition of a temporary but critical phase of the manpower situation, which requires prompt and decisive action to prevent serious crippling of the war program."

National Emergency Specifications for Buildings—Steel and Concrete

Attention of members is directed toward two recent developments for the purpose of wartime economy in structural design and building. These new provisions are here presented in abstract with the consent of responsible engineers of the War Production Board, Specifications Branch.

Structural Steel

On September 10, 1942, National Emergency Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings were established by the War Production Board. In WPB Directive No. 8, signed by Donald M. Nelson, chairman, it is ordered that these specifications apply to and govern the use of structural steel for all buildings which are constructed, financed, or approved by governmental agencies on contracts placed after November 9, 1942. The manual was developed under the direction of the Specifications Branch of the Conservation Division.

The purpose of the directive is to conserve the supply of structural steel by requiring the use of higher design unit stresses than are normally used in the design of structural steel for buildings. By using in design the higher unit stresses stipulated in these specifications, somewhat lighter sections of beams and other

members entering into the construction of buildings will be permitted, but not to an extent that in any way endangers the safety of the building.

The allowable stress for beams in flexure has been increased from previous allowances ranging from 16,000 to 20,000 lb per sq in. to a mandatory 24,000 lb per sq in. Other savings of steel are effected through the use of continuity in design and welded fabrication.

It is estimated that the use of these specifications will result in a saving of approximately 10% of the weight of structural steel entering into building construction. The actual tonnage of steel saved, of course, depends on the amount of future construction. Some quantitative measure of the saving is indicated by the statistics for 1941, which show that approximately 2 million tons of structural steel were used in the construction of buildings in that year.

Reinforced Concrete

On October 5, 1942, National Emergency Specifications for the Design of Reinforced Concrete Buildings were established by the War Production Board. In WPB Directive No. 9, signed by Chairman Donald M. Nelson, it is ordered that these specifications apply to and govern the use of reinforcing steel for all buildings which are constructed, financed, or approved by governmental agencies on contracts placed after January 1, 1943. This manual also was developed under the direction of the Specifications Branch of the Conservation Division.

The general purpose of this directive is the same as that of the previous one for structural steel; that is, it is aimed at conserving the supply of reinforcing steel by requiring the use of larger structural members and higher unit tensile stresses in reinforcing steel than normally are used in the design of reinforced concrete buildings. These specifications also are expected to considerably reduce the amount of reinforcing steel used in concrete buildings, but not in any such way as to create a hazard.

The allowable compressive unit stresses in concrete have been reduced, thus requiring larger structural members, with corresponding reductions in the amount of reinforcing steel needed. Further economy in the use of reinforcing steel is obtained by increasing the allowable unit tensile stress from 18,000 to 20,000 lb per sq in. for structural grade bars, and from 20,000 to 24,000 lb per sq in. for intermediate and hard-grade bars.

It is estimated that the use of these specifications will result in a saving of about 25% of the amount of reinforcing steel entering into building construction. The annual savings, it is estimated, may run between 150,000 and 250,000 net tons.

General

Broadly speaking, these manuals follow the policy stated in the "Joint Directive on War-Time Construction" made by WPB and the War and Navy Departments on May 20, 1942, and the "List of Prohibited Items for Construction Work" issued by the Army and Navy Munitions Board on April 1 and revised on June 29, 1942. The specifications are binding upon WPB, the Army, Navy, Maritime Commission, Reconstruction Finance Corporation, National Housing Agency, and all other Government departments and agencies in respect to war construction and the financing of war construction.

Agencies undertaking or approving war-time construction are directed to obtain from the person in charge of the design of each building a certificate to the effect that he has complied with the emergency specifications. In cases where Forms PD-200 and PD-200-A must be filed with WPB in order to obtain authorization to begin construction, this certificate should be filed with the forms. Authority to depart from the provisions of these directives may upon specific request be granted by the Director General for Operations of the War Production Board.

Copies of each of these specifications may be obtained free of charge from P. H. Colby, War Production Board, Room 1310, Railroad Retirement Building, Washington, D.C.

Brief Notes

THE American Standards Association has announced the publication of its newest List of American Standards for 1942. More than 550 are listed, of which 71 have been approved since the last (February 1942) issue of the list. There is a separate heading for American War Standards—those developed specifically for the war effort. Another section is devoted to American Safety Standards, also of great importance in connection with the conservation of manpower. The standards reach into every important engineering field and serve as a basis for many municipal, state, and federal regulations. A large part of the work of the A.S.A. is now on wartime jobs requested by Army, Navy, WPB, OPA, and industry. In fact, the A.S.A. is under contract with the federal government to carry on an increasing amount of such work. In each case, the standards approved represent general agreement by maker, seller, and user groups. More than 600 organizations are taking part. This List of American Standards for 1942 will be sent free on request to American Standards Association, 29 West 39th Street, New York, N.Y.

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IT was a member of the Society—John W. Wheeler, colonel, Corps of Engineers, U.S. Army—who was credited with making the hit speech of the ceremony which officially opened the Alcan highway. Colonel Wheeler's speech has also been quoted as a model of brevity. He said, "To the gang who built the Alcan highway, thanks a million."

* * * *

OSCAR SEWARD, JR., now a lieutenant colonel in the Corps of Engineers, has written from the West to some of his Texas friends that he has been in Canada and Alaska and on the Alcan Highway. "Everything," he says, "is wonderful. William H. Seward, when Secretary of State under Lincoln, bought Alaska. He was my great uncle. When I was in Juneau, the capital, I was invited to the Governor's Mansion and wined and dined. I had a wonderful time." Before he was commissioned Colonel Seward was senior resident engineer for the Texas State Highway Department at Groesbeck, Tex. He is a member of the Society.

* * * *

ACCEPTED for many years as "the safety man's bible," the "Handbook of Industrial Safety Standards" has been revised by the National Conservation Bureau, accident prevention division of the Association of Casualty and Surety Executives, to provide the latest safety developments and protective methods against sabotage and possible air raids for American war plants. The Handbook has the approval of the U.S. Department of Labor and is recommended by the U.S. Office of Education as supplemental reading in the engineering, science, and management defense training courses. It may be obtained from the National Conservation Bureau, 60 John Street, New York, N.Y., postpaid, for 55 cents in gray paper cover, or 75 cents in green leatherette cover with gold lettering. Quantity prices furnished on request.

* * * *

A "MANUAL for Committees of Engineers Who Aid Young Men interested in Engineering Education and the Engineering Profession" has recently been issued by the Engineers' Council for Professional Development, 29 West 39th Street, New York, N.Y. It has a separately bound appendix addressed to the student as a prospective engineer. The manual refers to the previously issued booklet, "Engineering as a Career," as a supplement, and offers a general procedure for presenting to high school students the aims and essentials of engineering education, and the types of civilian and armed forces needing engineers. Copies may be obtained from the above address at 10 cents a copy (discount on quantity orders).

* * * *

ON NOVEMBER 20 the American Institute of Mining and Metallurgical Engineers announced the election of the following officers: President, C. H. Mathewson, Chairman of the Department of Metallurgy, Yale University; and two vice-presidents, Erle V. Daveler, Utah Copper Company, New York, N.Y., and Harvey S. Mudd, consulting engineer, Los Angeles, Calif. Six directors were also elected: H. J. Brown, consulting engineer, West Newton, Mass.; Charles H. Herty, Jr., assistant to vice-president, Bethlehem Steel Company, Bethlehem, Pa.; O. H. Johnson, vice-president, Mines and Smelter Supply Company, Denver, Colo.; Russell B. Paul, Mining Engineer, N.J. Zinc Company, New York, N.Y.; F. A. Wardlaw, Jr., assistant manager, International Smelting and Refining Company, Salt Lake City, Utah; and Felix Edgar Wormser, secretary and treasurer, Lead Industries Association, New York, N.Y.

A Remarkable Chinese Military Bridge

By J. CHARLES RATHBUN, M. AM. SOC. C.E.

PROFESSOR OF CIVIL ENGINEERING, COLLEGE OF THE CITY OF NEW YORK, NEW YORK, N.Y.

THE Poh Lam Bridge is of special interest not only because of its engineering features but also because it throws some light on military methods as practiced in China three hundred years ago. When I last saw it, it was still in use. The Chinese build for permanency.

Koxinga, who had this bridge built, might be considered a Chinese pirate or patriot (depending where your sympathies lie). He commanded Formosa and the Chinese coast from north of Foochow to Indo-China, and refused to surrender to the Manchus. One of his strongholds was near Amoy, a seaport on the mainland opposite the island of Formosa.

To keep a way of retreat open and to maintain contact with the back country, he found it necessary to build this bridge across a tidal stream about twenty miles away. Although it was not possible to unearth documentary evidence of its history, the people of the district have handed down the story of the building of this bridge. This is the account they gave.

It appears that, as a matter of organization and to promote interest, the builders were assured that if the work did not progress well, or if and when the bridge failed, they were forthwith to join their ancestors in eternal peace. As a result there was little trouble from strikes, walkouts, or sabotage. All worked to complete the structure as soon and as well as possible.

The engineering features of the bridge are of equal interest. Its total length is 335 meters, or 1,100 ft. Originally it had 13 spans. So, considering the period and the location, it is truly a remarkable structure.

Near their tops the piers are wider than at the water's edge in order to reduce the clear span. They are built of rough-cut stone blocks. Although from the nature of the stream one would judge that the foundation was none too solid, these piers are in excellent condition, especially the 12 original ones. The stream is subject to violent floods. In the ensuing years it has been found easier to add new piers than to span the 70-ft gap when a girder fails. Five such piers have been added.

In plan, the bridge is straight both ways from the seventh pier—where a sharp angle occurs. It is placed there on purpose. In some way not quite clear to me, it is designed to control or perhaps to detour evil spirits that might wish to cross. This pier is surmounted by a tower.

The most remarkable feature of the bridge is the design of the spans. These consist of granite girders 6 ft wide, 5 ft deep, and as much as 70 ft long. Three of these side by side constitute a span. The quarrying of these girders, their loading on barges, their transportation and placing, all present problems requiring engineering ability and skill of a major character. And, if tradition is correct, failure was fatal.

These builders must have had great courage or a knowledge of beam theory better than Westerners at that time. It is of interest to compute the stress under dead load of that granite. Some tests made by the Whangpoo Conservancy Board in recent years show that granite beams will fail in tension at from 437 to 970 lb per sq in. at the point of rupture. The average of tests on grey granite showed 936 lb per sq in. at the center of the span at failure. On the Poh Lam Bridge live loads were, of course, light—pedestrians or draft animals and cattle.

VIEW FROM WATER LEVEL

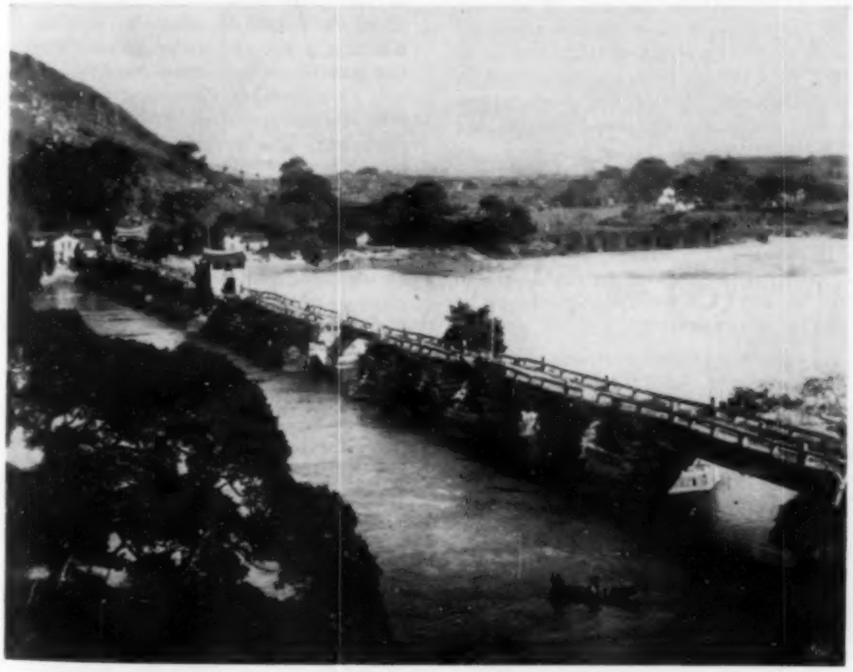
Span Just to Right of the Large Tree Is One of the Longest in the Bridge

So much for the bridge. As for Koxinga, its builder (1623–1663), many interesting stories are told of him. He was born in Japan of a Chinese pirate father and a Japanese mother. As a pirate the father accumulated some 3,000 fighting junks and became admiral of the Chinese Imperial Fleet. When the Ming Emperor was defeated this loyal admiral joined the Manchus on the promise of being rewarded and made a Manchu prince. Instead, he was put in jail and soon died of throat trouble (external). His darling son, Koxinga, took the Emperor, the fleet, and everything else not nailed down and fled south to Foochow and Amoy.

Koxinga was now a pirate, an admiral, and a patriot with a price on his head. He must have inherited great ability for he soon owned and controlled Formosa as well as a long stretch of the mainland. He sent the now classical answer to the Manchu ruler: "Come and get me."

In Amoy the people are still loyal to his memory. His followers refused to wear the cue and many of the country people followed him in this. Those who did not wish to be killed by either side took up the custom of wearing a turban. This custom was followed till the Manchus were overthrown. The people are proud of the fact that Amoy was the last place in China to surrender to the invaders, and to wear the badge of servility, the cue. This is probably one of the few places where Chinese wear turbans.

Today his Poh Lam Bridge is a historic structure. From the vantage point of present knowledge it is evident that it was far ahead of its time, with a stone girder 70 ft long, a clear span of at least 80 ft at the water, and in at least one span a distance of 70 ft from edge to edge of support. Were there any spans longer than this in the world in 1663 except the Rainbow Arch in Arizona? Was there any longer bridge (1,100 ft) from first to last pier?



GENERAL VIEW OF POH LAM BRIDGE

Tower Across Bridge Roadway Marks Angle in Alinement

NEWS OF ENGINEERS

Personal Items About Society Members

REINHOLD B. HANSEN, formerly with the Hetch Hetchy Water Supply Project of the City and County of San Francisco, is now construction engineer for the Maritime Commission, with offices in Oakland, Calif.

JOHN S. MARSHALL has been commissioned a captain in the Corps of Engineers, U.S. Army, and is stationed at the Colorado Springs air base, where he is assistant to the area engineer. Until lately he was chief draftsman for the Colorado State Highway Department at Denver.

FRANK M. KELLER, who is area engineer in charge of construction at the Utah Quartermaster Depot, stationed at Ogden, has been promoted from the rank of major to that of lieutenant colonel.

RAY WARREN was recently called to active duty in the Corps of Engineers, U.S. Army, with the rank of major, and has been assigned as area engineer at Camp Davis, N.C. He was previously director of the Greensboro (N.C.) Housing Authority.

WILLIAM HENRY HOLMES has been appointed supervising engineer in charge of design and safety of dams for the California State Department of Public Works. Mr. Holmes, who was formerly hydraulic engineer for the department, succeeds the late GEORGE W. HAWLEY in this new capacity.

HENRY J. MILES, until lately assistant professor of civil engineering at the University of Florida, is now associate professor of civil engineering at the University of Southern California.

TIM DEJONG has entered the Civil Engineering Corps of the U.S. Navy, with the rank of lieutenant. He was previously civil engineer and surveyor for Clatsop County, Oregon.

W. C. STRECKER, who is a major in the Construction Quartermaster Corps of the Army, has been assigned as area engineer at an air base in Nebraska.

ERVIN L. KNEBES, assistant city engineer of Milwaukee, Wis., is the recipient of the "veterans' award" of the American Public Works Association. The presentation was made at the annual convention banquet of the association, which was held in Cleveland, Ohio, in October.

CHARLES M. PICKETT, captain, Corps of Engineers, U.S. Army, has been assigned to the Massachusetts Institute of Technology as a professor of military science and tactics. Captain Pickett was recently stationed at Camp Butner, N.C.

ALBERT E. CUMMINGS and RALPH B. PECK have been appointed lecturers on the civil engineering staff of the University of Illinois. Mr. Cummings is district manager of the Raymond Concrete Pile Company at Chicago, and Mr. Peck, assistant subway engineer for the Chicago Department of Subways and Traction.

ERNEST W. STEEL, lieutenant colonel, Corps of Engineers, U.S. Army, has been detailed as adviser to the division of sanitary engineering of the Venezuela Ministry of Health. Colonel Steel, who is on leave from his post as professor of municipal and sanitary engineering at the Agricultural and Mechanical College of Texas, was previously liaison officer to the Coordinator of Inter-American Affairs.

CHARLES R. BLOOD has been granted a leave of absence from his position as assistant city engineer of Sacramento in order to report for active duty as a senior engineer with the Corps of Engineers, U.S. Army. He has the rank of major.

GEORGE M. HALEY, major, Corps of Engineers, U.S. Army, has been transferred from Kearns, Utah, where he was area engineer at the army air force basic training center, to Wendover, Utah.

CHARLES G. PRAHL, lieutenant, Civil Engineering Corps, U.S. Navy, has been ordered to the Naval Construction Training Center at Norfolk, Va., for service with the Navy Construction Battalions.

J. T. BULLEN was recently elected superintendent of public works for the East Baton Rouge (La.) parish. He was formerly parish engineer for Caddo, La.

TOM JOHNSON ALLEN, recently commissioned a major in the Corps of Engineers, U.S. Army, has gone to Miami, Fla., where he will begin a tour of the U.S. Army's Caribbean bases.

ARTHUR RICHARDS, executive engineer of Larchmont, N.Y., was reelected president of the American Association of Engineers at the twenty-ninth annual meeting of the organization, which was held in Chicago in October.

R. D. LANDON is on leave of absence from his post as professor of civil engineering at Southern Methodist University in order to serve as field representative in the engineering, science, and management of war training. His headquarters are in Washington, D.C.

ENOCH R. NEEDLES, consulting engineer of New York, N.Y., has been commissioned a lieutenant colonel in the Corps of Engineers, U.S. Army. At present he is stationed in Washington, D.C. From 1937 to 1939 Colonel Needles served as Director of the Society.

N. HENRY GELLERT was recently elected chairman of the board and president of the American States Utilities Corporation, with headquarters in Philadelphia, Pa. Mr. Gellert retains his management business, through which he directs the operation of the Great Lakes Utilities Company and other organizations.

JACOB WEGWEISER, formerly office and safety engineer for the Mason and Hanger Company at Lackawack, N.Y., has been appointed lieutenant (jg) in the U.S. Naval Reserve, for active duty with the Civil Engineering Corps, assigned to the Construction Battalions.

DECEASED

THOMAS DAVID ALLIN (M. '06) civil engineer of Pasadena, Calif., died on October 17, 1942, at the age of 78. A native of Iowa, Mr. Allin moved to Pasadena in 1882, and in the ensuing years was continually active in the civic and engineering betterment of the city. He had been city engineer, city commissioner, and chairman of the City Planning Commission. With his brother he, for many years, maintained the engineering firm of Allin Brothers.

RUDOLPH CONRAD BECKER (Assoc. M. '12) owner of the Voss Ice Machine Works, New York, N.Y., died suddenly on November 20, 1942. He was 58. Mr. Becker was with the Consolidated Gas Company in 1906, and assistant engineer for the New York Board of Water Supply from 1906 to 1920. In the latter year he became owner of the Voss Ice Machine Works.

REX ELMER BUCKLEY (Assoc. M. '25) engineer in charge of construction for the Electro Metallurgical Company, of Glenn Ferris, W.Va., died on October 1, 1942, at the age of 52. Mr. Buckley was in the city engineer's office at Aberdeen, Wash., from 1900 to 1910, and from 1916 to 1924 with the Canadian Niagara Power Company. Later he was with the Boulevard and Bay Land and Development Company at St. Petersburg, Fla., and more recently was engineer in charge of construction for the New-Kanawha Power Company at Glenn Ferris.

EDWARD JAMES DOUGHERTY (M. '39) president of the E. J. Dougherty Construction Company, of Baltimore, Md., died on November 11, 1942. Mr. Dougherty, who was 53, was a former president of the Engineers' Club of Baltimore. From 1915 until 1941 he was with H. S. Kerbaugh, Inc., the George W. Rogers Construction Corporation, and the Empire Construction Company, acting successively as superintendent, general superintendent, and president. During this period he was engaged on many projects in various parts of the country.

CARLETON GREENE (M. '15) retired civil engineer, died at his home in South Orange, N.J., on November 14, 1942, at the age of 75. Early in his career Mr. Greene was with the New York Central and the Pennsylvania Railroads. Later he was for many years senior partner in the New York engineering firm of Greene and Greene, being the third in three successive generations of his family to head the firm founded by his grandfather. He moved to South Orange thirty years ago. Long a member of the Society, Mr. Greene served as Director from 1920 to 1922.

CLAUDE IRVING GRIMM (M. '26) head engineer for the U.S. Engineer Department at Portland, Ore., died on December 1, 1942. He was 56. Mr. Grimm was engaged in miscellaneous engineering work from 1908 to 1914, when he became con-

nected with the U.S. Engineer Department. He served the Department in Cincinnati, St. Louis, and San Francisco until 1933, when he was transferred to Portland. Mr. Grimm developed designs for Bonneville Dam and the Willamette Valley project.

David Edward Hughes (M. '05) consulting engineer of San Pedro, Calif., died in Long Beach on November 19, 1942. Mr. Hughes, who was 81, was for some years assistant engineer in the U.S. Engineer Office at San Pedro. He had assisted in the building of the San Pedro Bay breakwater and of Fort Rosecrans at San Diego, and taught engineering at Pierce College, College City, Calif.

Clayton Orton Judson (M. '41) since 1936 city engineer for St. Joseph, Mo., died recently at the age of 54. From 1909 to 1912 Mr. Judson was with the Chicago, Burlington and Quincy Railroad; from 1912 to 1917, surveyor in the U.S. Engineer Office at Rock Island, Ill.; from 1912 to 1933, president of the Judson Engineering and Construction Company; and from 1933 to 1937, county surveyor of Buchanan County, Missouri. During the first World War he served as first lieutenant in the U.S. Engineer Reserve Corps, stationed at Camp Lee, Va.

William Robert Kales (M. '24) president of Whitehead and Kales, of Detroit, Mich., was fatally stricken with a heart attack in his office on December 3, 1942. Mr. Kales, who was 72, established himself in Detroit in 1897. In 1899 he and the late James T. Whitehead founded the River Rouge structural steel works, which bears their name. His firm fabricated and erected all the structural steel used in the building of the Ford Bomber Plant and the two great Wright plants near Cincinnati. Mr. Kales gave much time to exploration and study in China and Japan and was known as an authoritative Orientalist. During the World War he served overseas with the Air Corps, returning with a captain's commission.

Robert Linton (M. '24) mining and industrial engineer of Los Angeles, Calif., died at his home in that city on November 12, 1942, at the age of 72. Mr. Linton was with the American Window Glass Company, of Pittsburgh, Pa., from 1894 to 1906; a member of the mining engineering firm, Atwater, Linton and Atwater, from 1906 to 1910; and in private practice from 1910 to 1923. He then became vice-president and general manager of the Pacific Clay Products Company, remaining in that capacity until 1935 when he returned to private consulting practice. Mr. Linton was consultant for the Los Angeles area on the Metals Reserve Board, and did valuable research work to aid the war effort in the field of mining.

Donald Smith McCalman (M. '22) died on October 21, 1942, at Greenville, Ill., where he had been working on a construction project. Mr. McCalman, who was 63, was senior engineer for the city of St. Louis, Mo., from 1933 until 1941. Earlier in his career he was engineer for the Highway Materials Company, of St. Louis.

Herman Stabler (M. '17) since 1925 chief of the conservation branch of the U.S. Geological Survey, Washington, D.C., died in that city on November 24, 1942. He was 63. Mr. Stabler had been with the U.S. Geological Survey since

Herman Stabler

1903, except for the period, 1908 to 1910, when he was with the U.S. Reclamation Service (now the Bureau of Reclamation). His early work with the Survey laid the foundation for the enactment and administration of laws governing the use of the public domain. A discoverer in the field of water analysis and disposal of commercial waste, Mr. Stabler was the author of numerous bulletins and papers on these subjects. Recently he had worked on the problem of increased oil and gas production, especially on public lands in the West. Long active in the affairs of the Society, he served as Director from 1935 to 1937.

Daniel Webster McMorris (M. '06) consulting engineer of Seattle, Wash., died in that city on November 9, 1942, at the age of 77. Mr. McMorris was for some years assistant city engineer of Seattle and, more recently, city engineer. Earlier in his career he was engaged on the construction of the fortifications for Corregidor in Manila Bay.

Fred Ashley Pneuman (M. '40) structural steel designer for the American Bridge Company in Chicago, Ill., died on November 30, 1942. Mr. Pneuman, who was 43, had been with the American Bridge Company since his graduation from the University of Colorado in 1922. He had designed cable-spinning equipment for the San Francisco–Oakland Bay Bridge and erection equipment for the Marine Parkway vertical-lift bridge at Rockaway Beach, N.Y.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Frank Calvin Roberts (M. '22) of Philadelphia, Pa., died at his home in Wynnewood, Pa., on November 30, 1942. His age was 81. For many years a consulting engineer with offices in Philadelphia, Mr. Roberts had designed and constructed projects in this country, Canada, Great Britain, and Spain. These projects included the design of more than seventy-five iron and steel plants for such firms as the Jones and Laughlin Steel Company of Pittsburgh; the Sheffield Coal and Iron Company of Alabama; and Bolchow Vaughn and Company and the Frodingham Iron and Steel Company, both of England.

Frank Sears Senior (M. '18) president of Senior and Palmer, Inc., of New York, N.Y., died at his home in Montclair, N.J., on November 29, 1942. Mr. Senior, who was 66, was with the Arthur McMullen Company from 1899 to 1929—from 1909 as vice-president. In 1929 he formed Senior and Palmer, New York construction contractors. During the first World War Mr. Senior served in France for eighteen months as a major in the Transportation Corps of the A.E.F., and was cited for "meritorious and conspicuous service."

Arthur Gregg Singer (M. '22) retired civil engineer of Philadelphia, Pa., died there on November 9, 1942, at the age of 69. Mr. Singer was in the Philadelphia Department of Public Works from 1893 until his retirement in 1933. During this long period he was, successively, assistant in the Bureau of Surveying; assistant engineer to the consultant on the abolition of grade crossings; district surveyor for the city; and finally assistant division engineer on grade crossings for the city.

John William Storrs (M. '14) retired consulting engineer of Concord, N.H., died on September 19, 1942. Mr. Storrs, who was 84, was with the Concord and Montreal and the Boston and Maine Railroads from 1890 to 1911, and later was chief of inspectors and consulting engineer for the New Hampshire Public Service Commission. From 1910 until his retirement he was a member of the bridge engineering firm of Storrs and Storrs. At the time of his death Mr. Storrs was mayor of Concord.

Ira Wallace Sylvester (M. '06) for many years city engineer of Alexandria, La., died on November 7, 1942, at the age of 74. Early in his career Mr. Sylvester was engaged in railroad work in the South, and at one time was special engineer to the Red River, Atchafalaya and Bayou Boeuf Levee District on flood-control work. From 1899 to 1903 and from 1905 on he was city engineer of Alexandria.

Irving Bernard Thorner (Assoc. M. '34) assistant engineer with the New York City Board of Water Supply, died recently at Downsville, N.Y. Mr. Thorner, who was 41, was with the New York City Board of Transportation from 1925 to 1933. Later he was tunnel designer for the New York City Tunnel Authority.

George Henry Tinker (M. '09) retired bridge engineer of Los Angeles,

Calif., died on October 1, 1942. Mr. Tinker, who was 74, had spent his career in the employ of various railroads. He had been with the Chicago, Burlington and Quincy Railroad and the Colorado and Wyoming Railway. From 1904 until his retirement in 1940 he was bridge engineer for the New York, Chicago and St. Louis Railroad, with headquarters in Cleveland, Ohio.

LEE HOOMES WILLIAMSON (M. '24) of Lewiston, N.Y., died on November 6, 1942, at the age of 51. During the first World War Mr. Williamson served with the A.E.F. in France, having the rank of lieutenant. Upon his return, he was in charge of constructing oil terminals in Puerto Rico, Brazil, Belgium, and Holland for the Texas Company. Later (1921 to 1933) he maintained a consulting engineering practice and, more recently, was with the Filtration Equipment Corporation, in New York City.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From November 10 to December 9, 1942, Inclusive

ACKERMAN, EDWARD (Jun. '42), Junior Naval Archt., U.S. Civ. Service Comm., Navy Yard (Res., 1312 Wyoming Ave., Philadelphia), Pa.

ADAMS, JOHN AMOS, JR. (Jun. '42), Junior Engr., U.S. Engr. Office, 4th and Gold, Albuquerque, N.Mex.

ADRIAN, GEORGE WASHINGTON (Jun. '42), Junior Physicist, U.S.N., Ordnance Bureau, Puget Sound Magnetic Survey Range, Kingston, Wash. (Res., 1031 West Kensington Rd., Los Angeles, Calif.)

ALLISON, JOHN DANIEL BRADSHAW, JR. (Jun. '42), Stress Analyst, El Segundo Div., Douglas Aircraft Co., El Segundo (Res., 2120 Strand, Hermosa Beach), Calif.

ALVY, REUBEN RALPH (Jun. '42), Junior Engr., Eastern Aircraft (Res., 9 Hollywood Ave.), Trenton, N.J.

ARTHUR, LYNN JENNINGS (M. '42), Associate Structural Engr., Public Works Dept., Puget Sound Navy Yard (Res., 1101 High St.), Bremerton, Wash.

BAILEY JOHN JOSEPH, JR. (Jun. '42), Ensign, CEC-V (S), U.S.N.R., Care, Res. Officer in Chg., Advance Base Depot, Port Hueneme, Calif.

BARDWELL, DAVID WILLIAM (Jun. '42), 2d Lt., Corps of Engrs., U.S. Army, 638th Engr. Camouflage Co., Presidio of San Francisco, Calif.

BARSH, NORMAN (Jun. '42), Structural Detailer, Am. Bridge Co., Gary, Ind. (Res., 3238 Augusta Blvd., Chicago, Ill.)

BATES, CLARENCE WOODROW (Jun. '42), 349 South Ferris Ave., Los Angeles, Calif.

BEARD, MARK WALLACE (Jun. '42), 2d Lt., U.S. Army, Company C, 151st Engrs., Army Post Office 941, Care, Postmaster, Seattle, Wash.

BEER, ROBERT GEORGE (Jun. '42), Ensign, CEC, U.S.N.R., Care, Jesse Beer, R.F.D. 4, Mansfield, Ohio.

BELZ, CHARLES ALBERT (Assoc. M. '42), Sales Engr., Bethlehem Steel Co., Broad St. Station Bldg., Philadelphia, Pa.

BENDER LEON (Jun. '42), Junior Engr., U.S. Army, Engrs., Penn-Mutual Bldg., 11th Floor (Res., 1817 South 4th St.), Philadelphia, Pa.

BENTLEY, THOMAS ROSS (Jun. '42), Designing Engr., Blaw-Knox Div., 5001 Baum Blvd. (Res., 133 South Aiken Ave., East End), Pittsburgh, Pa.

BILLS, SAMUEL EDWARD (Jun. '42), Junior Civ. Engr., TVA, Kentucky Dam, Gilbertsville, Ky.

BIRNBAUM, ARNOLD (Jun. '42), Loftsman, Eastern Aircraft Div., Gen. Motors Corp., Linden (Res., 64 Union Ave., Irvington), N.J.

BOGREN, GEORGE GUSTAVE (M. '42), Capt., Sans Corps., U.S. Army, Dow Field, Bangor, Me.

BOLTON, WILLARD RILEY (Jun. '42), Liaison Engr. (Contact), Curtiss-Wright Corp., Columbus, Ohio.

BOWERS, CHARLES EDWARD (Jun. '42), 4922 Hampden Lane, Bethesda, Md.

BOYCE, GIFFORD RAYMOND (Jun. '42), 78 Franklin St., Kingston, N.Y.

BOYLE, FRANK JOSEPH (Assoc. M. '42), Designer-Engr., Allegheny County Dept. of Public Works, County Office Bldg. (Res., 5920 Wellesley Ave., East End), Pittsburgh, Pa.

BRADFORD, LEWIS PITTS (Jun. '42), With U.S. Army, Sanatorium, Miss.

BRADSTOCK, NORMAN EDGAR (Jun. '42), 32 Fifteenth Ave., Columbus, Ohio.

BREMERMAN, DALE VINCENT (Jun. '42), Junior Engr., Mech. Testing Laboratory, Wright Field (Res., 50 West Mumma Ave.), Dayton, Ohio.

BROCKSCHINK, FRANK ROY, JR. (Jun. '42), 2d Lt., U.S. Army, 75th Engr. Company (L.B.), Camp Beauregard, La.

BROCKWEHL, DONALD ROBERT (Jun. '42), Engr., Bethlehem Steel Co., Rankin (Res., 1339 Shady Ave., Pittsburgh), Pa.

BROOKS, JOSEPH BOYD (Jun. '42), 2d Lt., Corps of Engrs., U.S. Army, H. and S. Company, 151st Engrs., Army Post Office 944, Care, Postmaster, Seattle, Wash.

BROWN, LEONARD NORWAY (Jun. '42), With U.S. Marine Corps Reserve, Box 511, Camp Verde, Ariz.

BRUCE, WILLIAM HENRY, JR. (Assoc. M. '42), Area Engr., U.S. Engr., Dept., Box 31, Cape May, N.J.

BRYAN, HARRY MEREDITH, JR. (Jun. '42), 2d Lt. Air Corps, U.S. Army, 306th Sub-Depot, Eng. Dale Mabry Field, Tallahassee, Fla.

BURGER, WARREN FRANCIS (Jun. '42), Ensign, CEC, U.S.N.R., Navy 8120, Care, Fleet Post Office, San Francisco, Calif.

CAMPING, HAROLD EGBERT (Jun. '42), 787 Alcatraz, Oakland, Calif.

CARTER, JACK WARREN (Jun. '42), Box 72, Rainelle, W.Va.

CASSON, LOYD THOMAS (Assoc. M. '42), Bridge Engr., Terminal R.R. Assn., 357 Union Station, St. Louis, Mo.

CAVANAUGH, DAVID JAMES (Jun. '42), Ensign, U.S.N., 6th Naval Constr. Battalion, U.U.B., Care, Postmaster, San Francisco, Calif.

CELUCH, JOSEPH JOHN (Assoc. M. '42), Supt. of Constr., Vermilya-Brown Co., Inc., 100 East 42d St., New York, N.Y.

CHRISTENSEN, GEORGE JAY (Jun. '42), Chf. Engr., Pacific Bridge Co., Box 398, Alameda (Res., 233 Ramona Ave., El Cerrito), Calif.

CHRISTOFFEL, LEWIS WILSON (Jun. '42), Junior Engr., TVA, 804 Broad St., Elizabethton, Tenn.

CHUN, RAYMOND KEONG (Jun. '42), Junior Hydr. Engr., U.S. Geological Survey, 225 Federal Bldg. (Res., 527 North Judd St.), Honolulu, Hawaii.

TOTAL MEMBERSHIP AS OF DECEMBER 9, 1942

Members	5,865
Associate Members	7,076
Corporate Members	12,941
Honorary Members	37
Juniors	5,238
Affiliates	71
Fellows	1
Total, Dec. 9, 1942	18,288
(Total, Dec. 9, 1941	17,383)

CLARK, WILLIAM WINFIELD (Jun. '42), Junior Civ. Engr., TVA, 201 Pound Bldg., Chattanooga, Tenn.

CLINE, JOHN HENRY (Jun. '42), Structural Draftsman and Designer, D. R. Warren, Lathram Sq. Bldg., 4th Floor (Res., 4111 Allendale Ave.), Oakland, Calif.

CLINGER, CHARLES BURKE (Jun. '42), Asst. Office Engr., Myers, Noyes & Lemmon, St. Angelus Hotel, San Angelo, Tex.

CLOUGH, RAY WILLIAM (Jun. '42), Aviation Cadet (Meteorology), Air Force, U.S. Army, 276 South El Molino Ave., Pasadena, Calif.

COCKRELL, JOSEPH OSBORNE (Jun. '42), 2d Lt., Corps of Engrs., U.S. Army, 802 Lomax St., Jacksonville, Fla.

COGAN, MYLES HONOHAN RESUGGAN (Assoc. M. '42), Designing Eng. Draftsman, Chemical Div., Shell Oil Co., Inc., Deer Park (Res., 1105 Elgin St., Houston), Tex.

COLLIGNON, ROBERT FAIRBANKS (Jun. '42), Party Chf., Surveys, Russell & Axon, Malden, Mo.

COOK, LELAND BLANCHARD (Jun. '42), Hull Planning Engr., Ingalls Shipbuilding Corp. (Res. 1019 William St.), Pascagoula, Miss.

COX, RICHARD HORTON (Jun. '42), Research Asst., California Inst. of Technology, 1201 East California (Res., 174 North Madison Ave.), Pasadena, Calif.

CRANDALL, DAVID LYNN (Jun. '42), Ensign, CEC, U.S.N.R., Public Works, Navy Yard, Philadelphia, Pa.

CRAWFORD, DAVID (Assoc. M. '42), Civ. Engr., State Div. of Highways, 819 Depot Ave. (Res., 1717 West 2d St.), Dixon, Ill.

CRONIN, BERNARD FRANCIS (Jun. '42), Ship Engr., Chicago Bridge & Iron Co., Seneca Ship Yard (Res., Seneca War Homes), Seneca, Ill.

CROSSLEY, NORMAN SHEPHERD (Jun. '42), Ensign, U.S.N.R., 13 Lyman St., Laconia, N.H.

CULLMER, ROBERT EDWARD (Jun. '42), (LaMesa Eng. Service), 4852 Cypress St., La Mesa, Calif.

DALLEY, PARLEY JAMES (Jun. '42), Ensign, U.S.N.R., 366 Commonwealth Ave., Boston, Mass.

DEGENKOLB, ORIS HERMAN (Jun. '42), Naval Archt., U.S.N.R., Naval Training Station, Mass. Inst. Tech., Cambridge, Mass.

DEVINE, WALTER ANTHONY (M. '42), Town Engr., Eng. Dept., 25 Town Hall, Brookline, Mass.

DONAHEY, MICHAEL HAROLD (Jun. '42), Care, Dept. of Civ. Eng., Yale Univ., 120 Winchester Hall, New Haven, Conn.

DRAKE, CHESTER MYRICK, JR. (Jun. '42), Instr., Virginia Military Inst. (Res., 308 Letcher Ave.), Lexington, Va.

DUFFE, BERNARD HARRY (Jun. '42), Ensign, CEC-V (S), U.S.N.R., Wilton Junction, Iowa.

DUKE, ROBERT KERR (Jun. '42), 2d Lt., U.S. Marine Corps, Company A, 14th R.O.C., B Barracks, Quantico, Va.

EBERHARDT, ANDREW (Assoc. M. '42), Structural Designer, Harza Eng. Co., 205 West Wacker Drive, Chicago (Res., 2319 Pioneer Rd., Evanston), Ill.

EISELE, CHARLES FREDERICK (Jan. '42), 2d Lt., Corps of Engrs., U.S. Army, 614 Eighth Ave., South, Grand Forks, N.Dak.

Eng, Kai Wah Gerald (Jun. '42), Junior Naval Archt., Puget Sound Navy Yard, Bremerton (Res., 1835 King St., Seattle), Wash.

Essick, Paul Jones, Jr. (M. '42), Deputy Chf., Bureau of Highways and Street Cleaning, 1032 City Hall Annex (Res., 6630 North 5th St.), Philadelphia, Pa.

Farr, John Baird (Jun. '42), Supervisor, Design Div., Brewster Aeronautical Corp., Northern Blvd. and 36th St., Long Island City, N.Y. (Res., 889 River Rd., Teaneck, N.J.).

Feller, Richard Tabler (Jun. '42), Asst. to Superv. Engr., Defense Plant Corp., Bendix Aviation Corp. (Res., Y.M.C.A.), South Bend, Ind.

Fenton, Richard (Jun. '42), Junior Estimator, Eastern Aircraft, Parkway Ave. (Res., 645 Edgewood Ave.), Trenton, N.J.

Ford, John, Jr. (Jun. '42), Ocean St., Marshfield, Mass.

Fowler, Harry Charles (Jun. '42), Engr., Contacting Shop, Curtiss-Wright Corp., Buffalo (Res., 82 Pardee Ave., Lancaster), N.Y.

Franzini, Joseph Bernard, Jr. (Jun. '42), 294 South Roosevelt Ave., Pasadena, Calif.

Garrison, Delmer George (Assoc. M. '42), Western Regional Engr., Sun Oil Co., 2117 National Bank Bldg., Detroit, Mich.

Garrison, Gerald Ray (Jun. '42), Junior Naval Archt., Puget Sound Navy Yard, Bremerton (Res., Vashon), Wash.

Georgi, Charles Otto (Jun. '42), With E. I. du Pont de Nemours & Co., Rosemount (Res., 533 Portland Ave., St. Paul), Minn.

Gerhardt, Louis Mathew (M. '42), Stuctural Engr., Eastman Kodak Co., 1669 Lake Ave. (Res., 162 Bryan St.), Rochester, N.Y.

Gillmore, Neil David (Jun. '42), Shop Contact, North Am. Aviation Corp., Kansas City, Kans. (Res., 3624 Harrison, Kansas City, Mo.)

Goebert, Walter Glenn (Jun. '42), Stress Analyst, Airplane Div., Curtiss-Wright Corp., Robertson, Mo. (Res., 1316 Broadway, East McKeesport, Pa.)

Goetz, Harvey John (Jun. '42), Junior Engr., The Dorr Co., Inc., Westport, Conn.

Gommel, Ernest William, Jr. (Jun. '42), Plant Engr., The Steel Tank & Pipe Co., 1100 Fourth St., Berkeley, Calif.

Gorgenson, Eric George Leonard (M. '42), City Bridge Engr., 209 City Hall (Res., 4733 Washburn Ave., South), Minneapolis, Minn.

Gregory, William Edmund (Jun. '42), Eng. Draftsman, Chicago Bridge & Iron Co., Box 277 (Res., 234 North 48th St.), Birmingham, Ala.

Griffin, Henry Porter (Assoc. M. '42), Associate Engr. and Supt., Constr., Corps of Engrs., War Dept., Moore Field, Mission (Res., 403 North 12th St., McAllen), Tex.

Guenther, Jack Gaylord (Jun. '42), Ensign, CEC, U.S.N.R., 1887 Cleveland Ave., Niagara Falls, N.Y.

Guillermety, Luis Manuel, Jr. (Assoc. M. '42), Chf., Eng. Div., Piers and Harbors, Dept. of Interior, San Juan (Res., 24 Wilson St., Santurce), Puerto Rico.

Hagedorn, John Carl (Jun. '42), 53-00 Sixty-Fifth Pl., Maspeth, N.Y.

Hallin, Norman Gustav (Jun. '42), Junior Naval Archt., U.S.N., Bethlehem Steel, Terminal Island (Res., 5588 A St., Irmo Walk, Long Beach), Calif.

Hardy, Calnon Leo, Jr. (Jun. '42), Draftsman, New York Central R.R., 15th St. Terminal (Res., 19411 Lancashire Rd.), Detroit, Mich.

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Hastings, Raymond Isham (Jun. '42), Ensign, U.S.N.R., Gilsum, N.H.

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BROWN, VICTOR JACOB, Assoc. M., reinstated Nov. 20, 1942.

MACY, GLENN DAVIS, M., reinstated Nov. 13, 1942.

SMITH, ROBERT JOSEPH, M., reinstated Nov. 18, 1942.

SPICKARD, HAROLD EWING, M., reinstated Nov. 30, 1942.

WALKER, EDWARD MANSFIELD, M., reinstated Nov. 17, 1942.

WOLFFE, WESLEY AMBROSE, Assoc. M., reinstated Nov. 13, 1942.

RESIGNATIONS

GROSS, HENRY MCCORMICK, Assoc. M., resigned Dec. 1, 1942.

HODGES, MCCLOUD BRADFORD, M., resigned Dec. 1, 1942.

SAYER, FRED DENNISTON, Assoc. M., resigned Nov. 24, 1942.

WHITE, FRANK PAUL, Assoc. M., resigned Dec. 1, 1942.

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